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PROGRESSIVE MEDICINE

A QUARTERLY DIGEST OF ADVANCES, DISCOVERIES
AND IMPROVEMENTS

IN THE
MEDICAL AND SURGICAL SCIENCES

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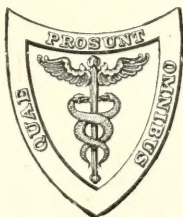
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VOLUME I. MARCH, 1919

SURGERY OF THE HEAD, NECK AND BREAST—SURGERY OF THE THORAX, EXCLUD-
ING DISEASES OF THE BREAST—INFECTIOUS DISEASES, INCLUDING ACUTE
RHEUMATISM, CROUPOUS PNEUMONIA AND INFLUENZA—DISEASES
OF CHILDREN—RHINOLOGY, LARYNGOLOGY AND OTOTOLOGY



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CONTENTS OF VOLUME I

SURGERY OF THE HEAD, NECK AND BREAST	17
By CHARLES H. FRAZIER, M.D.	
SURGERY OF THE THORAX, EXCLUDING DISEASES OF THE BREAST	109
By GEORGE P. MÜLLER, M.D.	
INFECTIOUS DISEASES, INCLUDING ACUTE RHEUMATISM, CROUPOUS PNEUMONIA AND INFLUENZA	151
By JOHN RUHRÄH, M.D.	
DISEASES OF CHILDREN	245
By FLOYD M. CRANDALL, M.D.	
RHINOLOGY, LARYNGOLOGY AND OTOTOLOGY	269
By GEORGE L. RICHARDS, M.D.	
INDEX	335

PROGRESSIVE MEDICINE.

MARCH, 1919.

SURGERY OF THE HEAD, NECK AND BREAST.

BY CHARLES H. FRAZIER, M.D.

THE BRAIN.

Gunshot Injuries of Skull and Brain. Naturally, the first consideration in this review of Head Surgery is given to gunshot wounds and associated conditions, and though the armistice has been declared and hostilities suspended, it is both interesting and instructive to review this phase of military surgery and to hear the last word upon this subject. The war, from the standpoint of military medicine, using the term in its broadest sense, may be divided into three periods: the first, the period of organization and of attempts, futile often, of the adaptation of civilian to military conditions; the second, the constructive period in which ineffective methods were discarded, new methods "tried out," a period in which those who had initiative and courage came to the fore; and the third period, characterized, I should say, by the standardization of methods which have been proved by actual test to be worthy of adaptation. After the good had been sorted from the bad, it remained to perfect details, elaborate niceties in technic, and, as I read the war literature of the past year, I can see a greater tendency toward unanimity of opinion, less disagreement as to essential principles, with occasional exceptions. In the first period, the American Surgeon played no part, the French and English were struggling with the problem of dealing with head wounds in large numbers and of untold severity, until finally the French broke away from their conservative ally, insistent upon prompt operation, within a few hours, not a few days, not at a base, but at an evacuation hospital. Whatever effect this development of the evacuation hospital upon a large scale may have had in other fields of surgery, in gunshot wounds of the head, it was, I believe, the big contribution of the war. The insistence upon early operation and thorough débridement, which more than any other factors helped to lower the mortality, these we owe to the French. Not coming in until the third period of the war, the opportunity for the American Surgeon was limited; the fundamental principles had already been established, but

by refinements in technic and by the training of special operating teams for the head cases, the work at the front was proceeding in a most effective manner when hostilities ceased.

I have selected for review this year the contribution of four surgeons who have had the opportunity of working in special neurological centers. The supply of articles has been somewhat limited, but even had there been a larger number, we would have found, I think, a great deal of repetition, both in practice and principle. As the reader reads these reviews and will refer to those of last year, he will be struck with a certain uniformity, both as to classification of injuries and as to the problems to be considered under treatment, the time of operation, the anesthetic, local or general, the incision, the skull fragments, opening the dura, removal of foreign bodies and drainage. Without wishing to anticipate what follows, I think the reader will find, comparing the final with the earlier stages of the war, tendencies in the following directions: (1) Resort to early operation. (2) Local rather than general anesthesia. (3) Removal *en bloc* of damaged tissues. (4) A more general disposition to explore beneath an intact dura. (5) Rather radical views as to the removal of foreign bodies. The operative technic, evolved by Cushing¹ comprised the following features: (1) The removal *en bloc*, rather than piecemeal, of the area of cranial penetration. (2) The detection of bony fragments with a catheter rather than a finger. (3) The removal of pulped and disorganized brain tissue by the suction method. (4) The disinfection of the wound with dichloramine.

The preliminary preparations for the operation include stereoscopic radiograms to determine the location and number of the indriven fragments, the shaving of the entire scalp and a careful neurological study. The latter, I am glad to see, is emphasized as important, for without such, it would be impossible to determine whether subsequent developments were due to the initial injury or to the operative trauma. Furthermore, it emphasizes the necessity of a corps of surgical assistants who have had training in the essentials of neurology, a need which was anticipated in this country by the establishment under the Surgeon-General's Office of neurosurgical schools for medical officers. Cushing aligns himself with those who advocate the use of local anesthesia (novocain 1 per cent., adrenalin 15 drops to 30 c.c.), administering one hour before the operation one-third grain omnopen, to be repeated if the patient is restless.

Coming now to the operation itself, he prefers the three-legged, or Isle of Man, incision for the ragged or gutter defects over the vault, and reserves the flap incision for wounds through muscle in the temporal or suboccipital regions. The tripod incisions are particularly advantageous in that they enable one to completely excise the tract and at the conclusion of the operation effect closure without tension. Furthermore, the center of the radiating incision corresponds to the defect in the dura, and, should an infected hernia develop, it is very much more effectively dealt with than if covered by a flap. I have seen a great many head

¹ British Medical Journal, Feb. 25, 1918.

injuries from overseas, as they passed through a reconstruction hospital, but have seen very few with this tripod incision.

Coming to the skull, Cushing prefers to remove the bone, including the site of penetration, *en bloc*, to piecemeal removal with rongeur forceps. The latter necessitates working through an infected territory. Four openings are drilled in the skull and these holes connected with a linear section. He advises, with others, the preservation of the mosaic of fragments as of importance, since, if incomplete, it implies that one or more fragments have been indriven and must be removed. He has abandoned the excision of the margin of the dural opening, since it predisposes to infection by breaking up adhesions, a point which has been emphasized very generally by military surgeons.

The point in technic, which is especially peculiar to his methods, is in dealing with the diorganized brain tissue. Having abandoned the finger for purposes of exploration and substituting the catheter, he uses the latter attached to a Carrel-Gentile glass syringe with the rubber bulb to evacuate the pulpy brain tissue. The latter, of the consistency of paste, is easily expressed, and the process is continued until the cavity is free. This can be determined by the fact that normal brain tissue will not be drawn into a tube by the traction applied by the average rubber bulb. If I may again refer to my experience with patients returning from overseas, I have been struck with the fact that in none thus far seen have the x-rays shown any retained deep-seated fragments of missile or bone. This speaks very creditably, I think, of the thoroughness with which our surgeons abroad are dealing with this phase of the problem. The remaining larger fragments of bone are removed with duckbill forceps, with this precaution, that attempts of removal of deep-seated bodies should not be forced to the point of increasing the damage already inflicted upon the nervous tissues. This point has been emphasized and observed by surgeons generally, in full realization of the fact that any unremoved foreign body may become the inciting agent of abscess formation. The removal of deep-seated missiles of appropriate material, that is, excluding lead, is best accomplished with the magnet.

One of the debatable questions in the technic of gunshot wounds of the head is as to whether an intact dura should be purposely incised, when the symptoms indicate functional disturbance or there is tension and discoloration. Cushing says that there is no doubt but that the period of convalescence and its attendant discomforts in this particular group of cases can be greatly lessened by opening the dura, but if the surgeon has any doubts of his technic or of the cleanliness of the wound, he had far better give the patient the chance of recovery without incision of the membrane. He believes since the employment of dichloramine-T in eucalyptus oil, there has been a notable reduction in the incidence of infection.

In a more recent contribution,² he discusses his experience with 250 consecutive cases of head injuries under the following groups:

Group 1. *Wounds of the Scalp.* In these cases he cautions against

² British Journal of Surgery, 1918, v, 558.

overlooking fractures of the skull, even though an x-ray may have been taken. In a lateral view, a slightly depressed fracture may not show. And even when the external table be intact, the internal table may be fractured and the underlying brain seriously contused by penetrating fragments.

Group 2. *Local Fractures with Intact Dura, with or without Cerebral Contusion.* In these he takes a more radical view as to opening the dura than in his earlier publications. Safeguarded by proper technic, there is no great danger in opening the dura, and, if the neurological symptoms point to subdural damage, the dura should be opened, as a result of which not only convalescence but restoration of function will be hastened. There are two types of local fractures, (a) the external table is intact, and the opening of the skull must be left to the individual judgment of the operator, and (b) where there is a depressed fracture of both tables and the skull is trephined routinely.

Group 3. *Wounds with Local Depressed Fractures, Laceration of the Dura and Cerebral Contusion.* Here, as in his earlier contributions, he advises the removal *en bloc* of the damaged bone. The frontal cases are relatively less serious than those in the occipital regions, probably because they are easier of access; the prognosis generally is good, because the brain has not protruded through the skull and been exposed to infection.

Group 4. *Wounds Usually of the Gutter Type; with Detached Bone Fragments Driven into the Brain.* The pathology of these has been described frequently since the early period of the war. The prognosis is seriously affected by the fact that the brain is exposed, that contaminated fragments are driven into the brain substance, and, if the ventricles be penetrated, the mortality is inevitably high. Of 39 cases in this group, in 14 the ventricle was penetrated, with a mortality of 42.8 per cent. As one would expect, the majority of these wounds are near the parietal vortex, consequently there is more or less damage to the motor cortex. In the vast majority of those I have seen, the defect is just to one side or other of the median line; they present the syndrome—spastic quadraplegia—as described by Holmes and Sargent. (Diverging for a moment to speak of this syndrome, the spastic nature of the paralysis must be of transitory duration. At least, I have observed, in the patients who have passed under my observation, that in the paralysis of these midline wounds, the spasticity is not a conspicuous feature.) Autopsies performed on the fatal cases with ventricular penetration revealed the cause of death in a localized or generalized infection, meningitis, abscess, encephalitis. Hence, the necessity of removing, whenever possible, all indriven foreign bodies.

Group 5. *Penetrating Wounds with Lodgment Both of Projectile and Bone Fragments.* As with group 4, the mortality is influenced by the penetration of the ventricles. This is a point repeatedly emphasized by all military surgeons writing upon the topic. Furthermore, there will be a higher mortality from penetration of a missile than of bone. In 41 cases in which the ventricle escaped, the mortality was 36.6 per cent., and when the missile entered the ventricle, the mortality was 100 per cent. To

show the effect on the mortality of the removal or non-removal of the missile, the following statistics are quoted: In 22 with removal, the mortality was 31.8 per cent., in 35 without removal, 60 per cent. While the majority of wounds of entrance were in the temporal region, the mortality was highest when the wound of entrance was in the parietal region.

Group 6. *Ventricles Penetrated or Traversed by Bone Fragments or Projectiles.* In this group, as in group 5, the mortality was higher with penetration of a missile than with that of a bone fragment, for the former 100 per cent., for the latter 42.8 per cent. The importance of attempting to remove the foreign body needs no further amplification. While many cases have recovered, as shown by more conservative writers, it is equally true that the retained fragment is the cause of a fatal encephalitis or brain abscess in many instances. Even when the ventricle is not primarily invaded, the infection may invade the ventricle in its normal relations or the ventricle, distorted by the protruding fungus, may rupture into the infected tract and become the seat of an overwhelming infection.

With regard to palliative measures, Cushing refers to lumbar puncture as affording but a very short period of relief and even a decompressive operation he thinks has a rather limited field in gunshot injuries of the head. If attempted, it should be the conventional subtemporal operation in a clean field with ample bony opening, and not a mere enlargement of the opening in the skull at the site of the fracture with a wide opening of the dura as practised in the early period of the war with disastrous results in many cases. The danger of bronchopneumonia in attempting to feed patients with inactive swallowing reflexes is alluded to and the advice given that feeding should never be attempted while the patient is still flat on his back. Stuporous patients should be kept in the semi-prone position.

In a contribution of this year,³ Gray describes the methods which he employed in the treatment of war wounds at the Casualty Clearing Stations. On admission, the patient's hair is shaved or removed with a depilatory paste, two x-rays are taken in planes at right angles to each other, and a neurological examination is made. The administration of 15 to 20 grains of urotropin every three or four hours is begun, and, whenever possible, a pathological examination is made of the discharge. His recommendation that no operation should be postponed longer than two days would seem to imply a rather conservative practice. If the wound seems inflamed and infiltrated, the application of hypertonic saline solution or paraffin paste will easily make it fit for excision in twenty-four to forty-eight hours.

As to the management of various types of injury: (1) for those cases without definite external signs of depressed fracture is recommended an exploratory operation, since one can never tell, even though the external table be intact, whether there may not be a fracture of the internal table and a subdural lesion. The indications for operation are par-

³ New York Medical Journal, 1918.

ticularly evident if there are signs of focal disturbances, together with signs of increased tension, such as headache, giddiness and papilloedema. (2) In depressed fractures without injury to the dura mater, the site of the fracture is removed *en bloc* by trephining to the outer side then encircling the lesion with DeVilbiss forceps. When the dura is muddy-looking, and when there is loss of pulsation, the dura should be opened for exploratory purpose. (3) Injuries of the dura without foreign bodies. The site of the cranial lesion is removed as in the previous types, fragments of bone are removed, the ragged edges of the dura excised and the tract beneath explored carefully with the finger, and the collection of disintegrated brain tissue will usually exude in the form of a paste. In these cases, he recommends employment of a drain of folded jaconet or small rubber tubing which is inserted down to, but not through, the dural opening to be removed in twenty-four hours. (4) Cases complicated by presence of foreign bodies and in some cases by sepsis. After the primary steps, as previously described in the preceding paragraphs, the tract is explored with the index finger, and, after localization of the foreign body, the latter is removed with the aid of a flat or slightly curved scoop passing along the finger under the foreign body, which is then pressed against the point of the finger and, with the aid of the scoop, withdrawn. In the management of these cases, curiously enough, he makes no mention of the employment of the magnet and even goes so far as to say that when the tract will not admit the finger, the foreign body may easily be left with safety. He justifies the method of exploring for foreign bodies with the finger at the primary operation on the following considerations: (a) because there is already a track in the brain substance; (b) because exploration with the finger adds nothing to the injury already inflicted; (c) because the foreign body, if allowed to remain, will easily be the starting-point of abscess formation; (d) because the track is probably already infected.

For the treatment of injury to the sinuses he advocates, as he did in his earlier writings, what has come to be known as the "postage stamp" method; that is, the immediate control of hemorrhage after exposure of the injured sinus with the index finger of one hand and the application of a small graft of fascia lata applied to the finger of the other hand. In his statement that practically all cases which survive the immediate effects of injury are amenable to this treatment, I gather that the injunction against operating for wounds of the longitudinal sinus, which emanated from the British clinics in the earlier periods of the war, no longer holds true.

Lumbar puncture is found of service in relieving both local and general evidences of pressure, such as spasmodic seizures, hernia cerebri, or even headache. When lumbar puncture fails, an attempt to relieve pressure by contralateral decompression is considered justifiable. In the treatment of hernia cerebri, he has found, as others, that the sitting posture has a favorable influence and in some cases recommends the use of the "bipp" paste.

As to the method of dealing with the wound in the scalp, the margins of the latter should be excised, and, when necessary, plastic methods,

or a U-, or S-shaped flap will serve to enable one to close the wound without undue tension. Should, however, there be much tension after closure the scalp should be scarified between the sutures sufficiently to allow the blood to escape. He seems to prefer, contrary to the practice of others, to have the site of the wound in the scalp to one side or the other of the wound in the dura so that the drainage tract is indirect, rather than direct.

Reviewing his experiences at a General Hospital during a period of ten months, at which 500 cases of gunshot wounds of the head passed through his hands, Graham⁴ outlines the technic which he followed. He preferred, and used almost universally, local anesthesia, giving $\frac{2}{3}$ grain of omnopon one-half hour before the operation, and injecting 2 per cent. solution of novocaine and adrenalin in a complete circle around the area to be operated upon. One of the advantages of local anesthesia is that the patient can sit up in bed immediately after the operation. Of the incisions, he used an elliptical extension of the original wound, and to expose wider, a triradiate incision, and in some cases a wide flap including the pericranium. The following varieties of wounds are described and discussed:

1. Fissure fractures without depression. In this, he trephines only when there are definite symptoms, either of focal character, or of general intracranial pressure. He is averse to opening the dura unless there be a large intradural clot. At all times he seems to have been driven from disaster of one kind or another to an extremely conservative attitude toward the question of dural incision. The risk of opening the dura, he thinks, probably more than counterbalances the risk of the patient's life in leaving the clot to absorb spontaneously. A decompression operation, aided by lumbar puncture, will suffice to tide over critical situations. "That the scarring resulting from the absorption and organization of clot and disintegrated brain is more prone to produce epilepsy than the scarring of an open drain tract is not proved."

2. In depressed fractures without injury to the dura, "masterly inactivity should be advocated," particularly in cases in which the outer table is not depressed. When there is an extensive depression of both tables and the patient suffers from evidence of focal and general pressure, the depressed bone is either removed or elevated.

3. Depressed fractures with the dura injured by indriven fragments of bone. With this he deals very much along the lines which have been advocated by other surgeons. He removes the bone area *en bloc*, and sometimes repairs the defect in the bone with a pericranial flap, closing the wound tightly and introducing a small lateral rubber glove drain down to, but not through, the dural opening. The rent in the dura should not be enlarged more than is absolutely necessary in order to minimize the danger of hernia and meningitis. Exploration of the tract is made with the finger.

4. In dealing with penetrating wounds with retained missiles in the brain, he is again rather conservative, referring to the English point of

⁴ British Medical Journal, Aug. 10, 1918.

view, as pronounced by Sargent and Holmes, that many patients with missiles retained deeply in the brain, recover, and are not more liable to serious complications than many whose brains have been lacerated and have not retained foreign bodies. The missile almost invariably occupies the deepest recesses of the brain tract, passing more deeply in than fragments of bone, and, as a rule, an abscess, should it develop, occurs around the retained bony fragment rather than the missile. Hence, he believes that one may be cautious in recommending the removal of deep-seated metal, should there be likelihood in so doing of further destruction of brain tissue.

In the prevention of meningitis and hernia, a careful toilet of the scalp wound and complete removal of all infected and damaged tissue is essential before trephining. To diminish the tendency toward herniation, he relies on posture, sedatives and lumbar puncture. The average amount of cerebrospinal fluid withdrawn is $\frac{1}{2}$ ounce. This amount seems to me larger than one should adopt as an average, because of the likelihood of meningitis from the sudden reduction of pressure. I am referring, of course, to cases in which meningitis has not developed. He still employs the old standby, urotropin, in large doses, and believes that with this and repeated lumbar punctures, he has been able to save cases in which meningitis was definitely established. His mortality for cases in which the dura was intact was less than 10 per cent., and where the dura was penetrated, just over 50 per cent. So far as he has been able to ascertain, he believes his results compare favorably with those operating in a similar field.

A very convenient and useful reference book on *Wounds of the Skull and Brain* by Chatelin and De Martel appeared this year as one of a series of Military Medical Manuals published by the University of London Press. The first part of this volume, with a preface by Prof. Marie, is given over to the pathology, physiology and symptomatology of wounds of the various lobes of the cerebrum and cerebellum, together with a consideration of the complications of brain wounds, such as meningitis, abscess, epilepsy and foreign bodies. The second part, by De Martel, deals with the surgical treatment of wounds. In a general consideration of the problems involved, De Martel expresses himself as follows: "The extreme urgency of cerebral operation, which is accepted almost as a dogma, is by no means proved. Intervention in a penetrating wound of the skull immediately after the injury, as it generally is practised, can only aggravate the infection by disseminating it. Indeed, the general practice is to enlarge the orifice of entry with a gouge-forceps. This clumsy instrument exercises repeated pressure on the brain and the dura mater, thus forcing into the subdural space the septic products contained in the damaged area limited by the adhesions. In what way does removal of a large area of the bone around the fracture, even if it be infected, benefit the patient? Men wounded in this way never die of osteomyelitis of the skull; that is not the danger. The immediate danger is almost exclusively meningitis, and the natural defences of the wounded man are much more effective against meningitis than the illusory help of surgery.

The surgeon must make up his mind that, as far as the brain and the meninges are concerned, he can do nothing, or next to nothing, against infection. The most that he can do is to do no harm, by exercising his prudence and lightness of hand so as to respect scrupulously the protective adhesions which have formed at the periphery of the traumatic area. In the case of the brain he should be satisfied with facilitating, by judicious drainage, the elimination of all the dead material the presence of which in the middle of the healthy brain substance facilitates, provokes and encourages infection, and this should be done only if the situation of the brain allows of it. This, in my opinion, should be the limit of the surgeon's action. Should there be a systematic search for metallic foreign bodies, which are the only ones shown with certainty by radiography? I do not think so, and yet this systematic and immediate search for foreign bodies is a dogma with many operators. Let it be borne in mind that the projectile up to the time of its arriving in contact with the tissues is aseptic, and has, a few seconds before, been raised to a temperature of several hundred degrees; in passing through the head gear, the hair, and the scalp it gets contaminated, but more than that, it draws behind it septic debris which will be the most active cause of infection, but which a radiograph will not show, and which there will never be any question of removing. Under these conditions there is no object in damaging the tissues anew as long as any encephalitis exists and metallic foreign bodies should only be extracted when this can be done by a method which is precise in the extreme, clean, free from hesitation, and without any rocking of instruments, or pushing backward and forward in the brain substance. The foreign body is often not far from the ventricular cavity, which is sometimes separated from the operation area only by a thin layer of brain substance."

With regard to the actual technic in dealing with wounds, the author seems disposed to prefer exposure by the flap method. To guard against hernia, he advocates Sargent's plan of loosening the pericranium from the scalp in such a way as to allow it to slide and to be sutured beneath the orifice in the latter. The brain can thus be perfectly covered in and the cutaneous wound quickly cicatrizes. Whenever an osteoplastic flap is practicable and, in this respect, De Martel's technic seems to differ from the majority of operators, he uses it because it affords a freer avenue of exposure, leaves no defect, serves temporarily for purposes of decompression, and is not followed by a cerebral hernia of mechanical origin, as is so often the case with the small classical trephining.

Speaking of epilepsy, he states that it is a common and comparatively late complication of injuries of the skull. This does not seem to be in accordance with the statistics published from other clinics in which the incidence of epilepsy seems to have been very much smaller than one would have anticipated from the character and nature of the injury. Except when the convulsive crises were due to localized compression of the brain by a splinter or foreign body, he has seen neither improvement nor cure after operation. The absurdity of opening the dura mater

on the pretext of separating adhesions, which reform more firmly than ever after the operation, is, in his opinion, perfectly evident. He seems to have had some satisfactory results by the use of radiotherapy applied to the cerebral cicatrix. He even goes so far as to say that if, as he hopes, radium will have some permanent effect in these cases, he will not hesitate to facilitate the action of the rays over the whole extent of the cicatrices by cutting an osteoplastic flap which he will raise on the occasion of each application. (This seems, to the uninitiated, like an extremely radical procedure and one which is not likely to meet with general endorsement by sober-minded people.)

For the extraction of foreign bodies, he prefers the use of the electro-magnet, using a Hirtz apparatus made entirely of copper except the indicator probe, which is of soft iron. The magnet weighs 80 kilos and has an attraction force of 160 kilos. Sometimes the foreign body will become detached, and, in order to detect this, one should use this instrument only under the control of the radioscope. For leaden bullets which will not be attracted by the magnetized probe, a special instrument is used with two jaws analogous to those of the forceps for the extraction of a foreign body from the esophagus. These procedures also must be controlled by the radioscope.

Various *incisions* have been used for the exposure of gunshot wounds of the cranium, such as the enlargement of the wound itself, the flap method of exposure, the three-legged or tripod incision. Schwartz and Moquot in the *Revue de Chirurgie*, vol. liii, p. 50, advocate an H-incision in which the transverse limb corresponds to the major axis of the wound. The perpendicular of the incision can be lengthened to any size that may be necessary for subsequent approximation. Referring to other points in the technic, the authors advise opening the dura only when there are signs of increased cranial tension or when the bluish tint of the dura indicates the presence of a subdural clot, or when the absence of fluctuation suggests a state of increased tension.

Payr⁵ recommends for the *drainage of cerebral wounds*, and as a substitute for glass and metal tubes, elderwood. The material is inexpensive and readily obtained. The drains are very much lighter than either glass or metal, they are hygroscopic and easily become adherent to the cerebral substance, not so readily displaced as rubber tubing, they can be cut in any length or thickness, can be disinfected by boiling, and to make them impervious, they may be soaked in liquid paraffin or melted wax. The materials of this drain have some advantages over other materials in that they are inexpensive, light in weight, do not cause pressure necrosis and are not readily displaced.

There are various *methods of removing foreign bodies*, chiefly the use of forceps and of the magnet. The latter should be used only with due consideration of the function of that portion of the brain which must be traversed as the foreign body is withdrawn. A great deal of unnecessary and permanent damage has been inflicted upon the brain by those who have been indifferent to, or ignorant of, the function of the brain

⁵ Deutsch. med. Wehnschr., 1917, xliii, No. 16.

at the seat of operation and, in the end, the condition of the patient is infinitely worse than before the foreign body was extracted. Rayner and Barkley,⁶ have devised a pair of extracting forceps to be used with the fluoroscope. These forceps are constructed with thin blades, the longer of which being rounded, and a connection is provided with an electrical bell, so that when the blades come in contact with the foreign body, the bell rings. By withdrawing the forceps slightly and opening the blades the foreign body can be grasped without inclusion of the surrounding structures. The authors are conservative in their attitude toward removal of foreign bodies, and believe the attempt should be made only in a few selected cases, such as those where it is possible to place foreign bodies in line between the eye of the operator and the x-ray tube. In latent cases without symptoms and where there is reason to believe the foreign body has already been surrounded by a fibrous capsule, no attempt at extraction should be made.

A rather fanciful theory has been advanced by Cortesi and Bonola⁷ as to *movement of foreign bodies in the brain and cord*. They recommend that in deeply seated projectiles, the wound in the brain should be lightly packed with sterile gauze. Subsequently the foreign bodies are localized with the x-ray, and the patient is put to bed with his head in such a position as to favor by gravity the displacement of the foreign bodies toward the cortex. When the foreign body has reached an accessible point, it is removed. This plan of procedure is based upon the theory that spontaneous displacement of foreign bodies takes place along the path in which the nerve tissue of the brain or cord has been softened by inflammatory processes. In war wounds, the path of these processes naturally would in most instances be represented by the course of the projectile.

At the outset I referred to this theory as somewhat fanciful, perhaps unjustly, since I have had no experience with its application. At the same time, it would seem a somewhat hazardous procedure to employ continuous gauze drainage in the brain awaiting the passage of a deep-seated foreign body toward the surface. Just how much time must elapse before this is accomplished I do not know, but in the meantime the danger of meningitis would not be remote. I should think that it would be very much safer to attempt to remove the foreign body at once with a magnet or even to leave it entirely alone than to establish continuous drainage from the surface to the deeper structures of the brain.

Superior Longitudinal Sinus. According to Ortali,⁸ there are some cases of wounds of the superior longitudinal sinus in which the method of closure with a graft of fascia of muscle is unsatisfactory. He refers particularly to extensive wounds in the posterior portion of the sinus where there is a confluence of veins and sinuses. For the control of these wounds, he proposes the employment of a pediculated flap taken from

⁶ British Medical Journal, 1918, i, p. 226.

⁷ Riforma med. Napoli, 1918, xxxlv, 365.

⁸ A Plastic Method in Wounds of the Superior Longitudinal Sinus, Cass. d. osp. e. d. clin. Milano, 1917, xxxviii, 1293.

the aponeurosis in the immediate neighborhood of the injury. The flap is secured in place with catgut or silk sutures.

Acute Pulmonary Edema in Gunshot Wounds. A rather interesting contribution to the cause of death in certain cases of gunshot wounds of the head has been made by Moutier. In 3 instances of wounds of this character under his own observation, death resulted within twenty hours from acute pulmonary edema. In searching for an explanation for this peculiar phenomena, the author finds a solution in a contribution of Rodgers upon an experimental study of the functions of the suprarenal capsules. When a relatively large dose of adrenalin was injected in the veins of animals, with its resulting increase in arterial tension, the animals died from an acute pulmonary edema. Moutier assumes that in these cases of gunshot wounds of the head there may be a hyperactivity of the suprarenal capsules which, with its resulting hypertension, is responsible for the pulmonary edema. This line of thought suggests to him the inappropriateness of using adrenalin as a therapeutic measure in intracranial injuries.

Complications and Remote Results of Gunshot Wounds of Skull and Brain. Naturally, at the outset I took up the methods of dealing with cranial injuries and the immediate results. It is appropriate now to turn to the complications and late results. How many of the returned soldiers will require surgical attention for the relief of certain sequellæ or how many will be able to return to their civilian activities and resume their former occupations? The answer to these questions will be found in the following articles, which I have chosen for review. But by way of preface I may very briefly present rather cursory observations upon upward of 100 cases, the first of our returning soldiers that have passed before me for review.

In almost all cases the wound was due to a high explosive shell, not a bullet. This would seem to imply that those who were struck by bullets either immediately succumbed or recovered sufficiently to return to active duty. There have been a few notable exceptions. In almost all cases the wound has healed and there is no cerebral hernia, a very common and troublesome complication. Either the hernia must have entirely receded during the healing process or the majority of cases with cerebral hernia must have died. The former no doubt is the likely explanation. Almost all the cases have cranial defects of smaller or larger proportion from one to six centimeters in diameter. In these defects there is some pulsation, but, in most, the scar tissue prevents any brain protrusion as the patient stoops over or lies down. The majority of the injuries are near the vortex, just to one side or other of the median line. There are a few cases of midline injury, with the picture of spastic paraplegia attributed by Holmes to compression of the longitudinal sinus. It has been said of these patients, who have sustained head injuries, that they are temperamentally unbalanced and I learned that abroad they have found it difficult to reestablish them satisfactorily in their occupational sphere. It is difficult, of course, to forecast what may be the reaction here of patients to home conditions when they are returned to civil life, but, as one observes their attitude

in the routine of a hospital existence, they are unusually free from any temperamental instability. It has been noticed also in the patients under observation that there is much less of what might be called the general, rather than the strictly focal, effects of the injury. One reads much of the headache, vertigo, tinnitus, photophobia, etc., that patients complain of who have sustained serious gunshot wounds of the head. Apart from vertigo, and that only of moderate degree, in stooping over or suddenly rising, and an exceptional case of headache, the patients seem unusually free subjectively and objectively from the effects of what must have been grave injuries. When the injury involved the motor area, there resulted of course more or less paralysis on the side opposite the injury usually involving both arm and leg, but one much more than the other. The progress which many of these cases have made in the recovery of power in the course of a few weeks has been surprising. There have been a few cases with injuries of other than the "motor" centers. A pathetic case was that of a captain struck by a missile which destroyed the visual center on both sides of the brain so that he was left totally blind. There have been a few cases with speech defects and aphasia, but these have improved wonderfully under the instruction of special teachers in the educational department. It is interesting to note that thus far there has not been discovered with the *x*-ray any retained deep-seated foreign body, either of bone or missiles. One must therefore assume that the original operation at the evacuation hospital must have been very thorough and included a search for, and removal of, in-driven foreign bodies.

So far as the treatment of these injuries or what remains of them in the process of reconstruction is concerned, it resolves itself into the repair of the cranial defect when that is large enough to need repair. Thus far the cartilage transplant from the ribs has been employed for this purpose and the operations have been uniformly successful.

We turn now to the investigation of Sargent and Holmes of the condition of 1239 patients from two to eighteen months after the infliction of the wound, and find them of interest. As to the mortality, only 46, or 3.7 per cent., died after admission to the London Hospital, and this number included 9 who died within two weeks. In the large majority, in 41 out of 46 cases, death occurred within three months. The immediate cause of death in most instances was the spread of infection, although in a few, death was due to intracranial hemorrhage.

TABLE OF THE CAUSES OF DEATH AFTER EVACUATION TO ENGLAND.

Intracranial hemorrhage	3
Following operation in England	11
Meningitis	10
Cerebral abscess	7

As to the physical disabilities, the amount of improvement of the paralyses, sensory and visual disturbances, was surprising. This was attributed to the fact that in large measure these functional disturbances must have been due not to local destruction of brain tissue, but to

concussion, edema and to vascular disturbances. According to Sargent and Holmes, it may be expected that a considerable proportion of men with severe head injuries will be able to lead useful and active lives. Especially striking has been the improvement in the hemiplegias, diplegias or quadriplegias due to longitudinal sinus injuries.

The proportion of cases in which either insanity or epilepsy developed was surprisingly low. During a period of twelve months only 8 patients developed mental symptoms necessitating their admission to an insane hospital, and, of these, 4 had been discharged as cured or improved, 1 had been previously insane, and 1 had dementia precox. In only 2 cases could the persisting mental symptoms be attributed to the head injury. What is true of the infrequency of insanity may be said also of epilepsy. Of 610 cases with complete records, 37, or 6 per cent., had had a convulsion, and in only 11 of these were the convulsions frequent. In several the convulsions were arrested by bromides, and in 5 by secondary operations. In 33 of 37 cases, the injury of the brain was of a serious character; severe compound fractures with involvement both of dura and brain tissue.

Of the other neurological conditions, there were, of course, various forms of paralysis, sensory and visual disturbances, due to the primary injury or subsequent complications, but, in addition, there were a large number of subjective disturbances, not attributable to any local injury. They seem to bear no relation at all either to the site or the severity of the injury. These subjective disturbances included symptoms usually associated with traumatic neurasthenia, such as headache, dizziness, emotional unrest and temperamental changes. There were only a few with major hysteria.

Of 610 cases of head injury returned to England, 120, or about 20 per cent., had a cerebral hernia. Classified as follows:

Of 96 penetrating wounds with retained missiles there were 20 hernias, or 20.8 per cent.

Following removal of missile at the base hospital or casualty clearing station (2 deaths)	6
Evacuated with missile retained (2 deaths)	14
Total	20

Of 68 cases of perforating wounds there were 14 cases of hernia, or 20.6 per cent.

Submitted to operation	10
Deaths	4
Wound completely healed	8

Of 310 cases of penetrating wounds without retained fragments, 86 cases, or 27.7 per cent.

Operated upon in France	62
Total deaths	19
Wounds completely healed	49

The most recent report on the late results of gunshot wounds of the head I found in a publication under the auspices of the Medical Research

Committee of Great Britain on a series of 656 cases. In the spring of 1916, arrangements were made for cases of gunshot wounds of the head to be evacuated to a given hospital for operation after they were fit for transport. This arrangement has continued, as a result of which it has been possible to assemble very comprehensive statistics covering this field. In presenting a report, Captain W. G. Adie and Captain W. W. Wagstaffe call attention to the fact that no extensive series of cases of gunshot wound of the head in which full notes have been kept and in which subsequent examinations have been made in all cases of death have so far been published in any language. With regard to the treatment of these cases, it was their practice to have the case x-rayed immediately after admission. The patient was then transferred to the ward, the dressing changed and the site of the wound cleansed as well as possible. After a period of from four to twenty-four hours, the patient was given a hypodermic and sent to the operating theatre. Evidently, these surgeons preferred a general anesthetic preceded by morphine and scopolamine for the following reasons: (a) the majority of patients have imperfect control of themselves and are liable to make sudden purposeless movements, (b) as the factor of time is an important one when a large number of cases have to be dealt with, and the employment of a local anesthetic takes from ten to fifteen minutes longer before the patient is ready for operation, (c) the surgeon should have absolute freedom in extending the operative field and this might become rather tedious under local anesthesia. With regard to the general steps of the operation, they have followed the recommendations of Sargent and Holmes. They employed a flap exposure rather than the three-legged incision, the bony opening was enlarged with rongeur forceps, bone and other easily accessible fragments were removed and the brain explored with the finger for deep fragments. The whole operation is performed under a stream of warm saline solution. The excised wound is sewed up with a rubber tube drain inserted down to the perforation in the dura and the flap sutured with rubber tube drains at the angles. Emphasis is laid upon rapidity in operation, the average time to complete the operation being thirty minutes. These patients seem easily shocked and it was noticeable how they improved when the flap was replaced. A more extensive experience has led them to the opinion that a more deliberate and thorough cleansing of the wound was indicated and that greater deliberation in reflecting the flap and in careful hemostasis were important points in the technic. As with other writers, emphasis is laid upon the paramount importance of skilled nursing. To insure the best results the most vigilant supervision on the part of the nurse is requisite. Patients with dural penetration were kept in bed, as a rule, for five or six weeks, at the end of which time they were evacuated to England as cot cases. Patients without dural penetration were evacuated to England about a fortnight after the subsidence of all symptoms.

I. GUNSHOT WOUND OF THE HEAD WITH PENETRATION OF THE DURA. The following table shows the result, so far as recoveries and complications were concerned, in those cases which were not operated upon before their admission to the General Hospital, and those which were operated

upon at the Casualty Clearing Station. The higher percentage of cases in the latter instance is a conspicuous feature. The higher percentage of complications is attributable to the fact that head cases stand transport very badly, and, whenever possible, they should be retained in the hospital in which the operation is performed for as long a period as possible.

RECOVERIES.

	Not operated on before admission to the General Hospital.	Operated on at Casualty Clearing Station.
Total number of recoveries	119	86
Total number of cases showing complications	16	38
Fits	6	5
Continued headache and pyrexia	8	20
Attacks of headache and vomiting	1	2
Persistent mental aberration	1	7
Persistent restlessness . . . . .	...	4
Percentage of complications	13	44
Average length of time under observation	41 days	37.6 days

The *mortality* in the two classes differs greatly, and it is difficult to compare them in any way. It was a fact, however, that the average time elapsing between the date of wound and the admission to the General Hospital of cases operated on at the casualty clearing station was 9.2 days. If the percentage of mortality is taken for those cases operated on here and dying after the ninth day, it is found to be 24 per cent. which closely corresponds with the mortality in cases operated upon at the casualty clearing station and transferred here subsequently, so that while there was a higher percentage of complications attributable to the effect of transport, they were seldom sufficiently severe to be fatal.

II. GUNSHOT WOUNDS OF THE HEAD INVOLVING FRACTURE OF THE SKULL BUT NOT PENETRATION OF THE DURA.

RECOVERIES.

	Not operated on before admission.	Operated on at casualty clearing station.
Trephined	35	36
Complications: total number	4	7
Fits	4	...
Persistent headache and pyrexia . . . . .	...	3
Attacks of headache and vomiting . . . . .	...	1
Persistent mental aberration . . . . .	...	3
Severe fractures. Not trephined	37	2
Complications: total number	2	1
Fits	1	...
Persistent headache and pyrexia . . . . .	...	1
Cerebral abscess	1	...
Slight fractures of under table; not trephined	33	14
Complications: total number	1	7
Fits	1	1
Persistent headache and pyrexia . . . . .	...	2
Attacks of headache and vomiting . . . . .	...	1
Persistent mental aberration . . . . .	...	3
Total number of cases	105	52
Total number of complications	7	15
Percentage of complications	6	28

In this group too it will be noted in the cases covered, the percentage of complications was higher than those which had to stand transport after operation.

With regard to the fatalities in this group: There were 13 deaths in 105 operations, a mortality of 12.38 per cent., and most of the deaths occurred in the first ten days, and half of these on the first day. The authors also call attention to the fact, as has been frequently noted, that one cannot tell from the appearance of the outer table of the skull whether the inner table is fractured, oftentimes not even with the aid of the x-ray. It is further noted that even when the dura is intact, it is possible for infection to reach the meninges. In many of their cases of depressed fractures in their early experience, the skull was not opened, but latterly they have become more inclined to trephine, not so much to relieve pressure as to aid the cleansing of the wound. In spite of that we note the following injunction: "*Incision of the dura we believe to be fundamentally incorrect and merely to expose the patient to a grave risk of intracranial infection.*"

III. GUNSHOT WOUNDS OF THE HEAD WITH SCALP WOUNDS. NO FRACTURE. Of these, there were 118, with 1 death as a result of pneumonia. Primary union was secured in only 70 per cent. of these cases.

IV. CASES SHOWING SEVERE CONCUSSIONAL CHANGES WITH OR WITHOUT FRACTURE OF THE BASE. Of these there were 2 deaths, 1 on the third day from cerebral congestion and pneumonia, and 1 on the first day from cerebral lacerations.

V. COMPLICATIONS. (a) Of these, attention is given first to what the authors call "*fits*," which occurred in 5 per cent. of the recoveries, usually during the first week after admission. They were never spread out over a period longer than three days; they never recurred and they were most common in cases where no operation was done on the skull or where the dura was intact or the brain only slightly damaged. It was noted, furthermore, that there was an exact correlation between the site of the wound and the nature and point of origin of the fits. Thus, an occipital wound would cause visual fits, a temporal wound gustatory fits, and a wound in the motor region convulsions. An interesting commentary is made upon the question as to whether the cases, which developed fits early and who had had no operation were more likely to develop traumatic epilepsy than other cases of head wounds. Nothing which the authors have learned from replies as to late results leads them to believe this to be the case. And again they are emphatic in the belief that the occurrence of fits alone does not justify an operation on an intact skull.

(b) In the majority of their fatal cases the cause of death is *meningitis*, and, in all but 4, the dura was penetrated. Usually, the patient continues to do well until the seventh to the tenth day, and one can never feel at ease until at least fourteen days have elapsed. The earliest sign of meningitis the authors noted was that with, or without, any rise of temperature, the patient becomes very much brighter, "he is talkative and amuses those around him with his quaint criticisms and remarks on his surroundings. Or, more commonly, he becomes querulous and is

considered by the inexperienced nurses to be merely 'naughty.' Within twenty-four hours, however, he begins to complain more insistently, the temperature rises, the neck becomes stiff, the ominous cry, 'Oh, my head' is heard; he becomes very restless, especially at night, and the typical meningitis is developed. All the fatal cases died within the first six weeks, the great majority before the end of the third week."

(c) *Cerebral Abscess.* Of these there were 14 cases, 13 deaths, and 1 recovery. Commenting upon this high mortality, the authors write, "We hope that we have learned something from the above cases, which will enable us to operate earlier and improve on these bad results." They found that the chance for the formation of an abscess was far greater when the wound was completely sealed than when a small drainage tube was left in the wound down to the hole in the dura.

(d) *Hernia.* As to the cause of hernia, it was noted that, apart from infection—that is, meningitis or abscess—insufficient decompression and early transport after operation were conducive factors. As a rule, with rest in bed the hernia slowly recedes, and, of the few cases evacuated to England with an unhealed wound, in only 3 was the hernia larger than a golf ball.

In the treatment of hernia, the following was their practice: (1) Rest in bed with the patient sitting up for a few hours daily and the application of a bandage with slight pressure. (2) Operation to increase the size of the bony opening was not countenanced because of the danger of secondary operations in head cases. (3) Lumbar puncture as a routine treatment in uncomplicated cases was considered unnecessary.

VI. PROGRESS OF PATIENTS EVACUATED TO ENGLAND. Of these, reports were received from 287, with the following results:

Discharged from the army	141
Returned to army work	81
Died	6
Disposal uncertain	59

Of the complications in this series, 35 per cent. showed some form of complication of which headache was the commonest. It was later noted that there were only 3 cases of fits, or about 1 per cent. Of other complications, the following is a summary:

Headache and vomiting	2
Headache and giddiness	6
Headache and mental derangement	4
Giddiness	3
Tinnitus	1
Amnesia	1
Mental derangement	4
Fits	3
Insomnia	1

In addition to the above complications, 43, or 15 per cent., showed persistent motor or sensory disturbances, of which 30 were slight and 13 severe. The following table shows the disposition of the patients:

Result as regards disposal (as noted on schedule).		Totals.
Discharged from Army.		
1. Permanently unfit		82
2. Unfit		34
3. Invalid		23
4. Invalid A		2
Total discharged from Army		141

Discharged to Army work.		
5. A 3		1
6. Fit		28
7. Fit C 3		5
8. Home service		1
9. Furlough and employment I		1
10. " " II		8
11. " " III		29
12. D I.		2
13. Con. Camp		3
14. Light duty		3
Total discharged to Army work		81

A very important contribution to the ultimate results and sequelæ of gunshot wounds of the head comes from the clinic of Villandre.⁹ Mass statistics have, as a rule, very little scientific value, but when there is available for study a large series of cases reported by a remarkably competent observer, the value of these statistics at once becomes of tremendous worth. Thus we find Villandre reporting the results of 450 cranial wounds in his own service and in estimating the cases requiring secondary intervention because of infection, he found 47 cases with cranial fistulæ and 14 with brain abscesses, and in 23 of these 47 cases a retained missile or fragment was found to be the cause of the persistent infection.

What is very much more surprising than the percentage of cases in which operation was required for persistent infection is the percentage of cases in which secondary operation was necessary in the absence of infection. Of these 450 cranial wounds, there were 303 secondary operations, for which the sole indications were the development of epileptic seizures. In other words, almost 70 per cent. of these cases developed epilepsy. This seems incredible.

The lessons which he says should be drawn from his observations are, (1) the extraction of foreign objects at as early a date as possible, and (2) the adoption of a system whereby there is a proper coöperation between the First Aid Station and hospitals back of the line, and (3) the establishment of special surgical units to which all head injuries should be referred.

At the Third Interallied Congress for the Study of War Wounds, which was held in Val-de-Grace, November 5 to 8, 1917, a number of subjects were discussed, including TREATMENT OF SECONDARY AND LATE COMPLICATIONS OF BRAIN WOUNDS. The statistics of Holmes were presented, which included 2357 cases of gunshot wounds of the head which had found their way to the hospitals in Great Britain. In 1567 of these cases there was an opportunity to study secondary complications for periods varying from three months to two or three years. Included in these complications were 37 cases of secondary abscesses, of which number 28 terminated fatally, a mortality of 75.67 per cent. There were 20 deaths and 70 complete recoveries in 90 cases of large cerebral hernias. In a considerable number of these cases there were

⁹ Cicatrisation des plaies du crâne au point de vue chirurgical. Arch. de méd. et pharm. mil., Paris, 1917, lxxviii.

large cranial defects, but practically none exhibited symptoms, either objective or subjective, which seemed to bear any relation to the cranial defect, so that in these 90 cases there were only 8 considered suitable for plastic repairing.

Oddly enough, as it seems to us, the British prefer a metallic plate to a bone or cartilage graft.

Of retained missiles there were 164 cases, covering a period of two or three years, of which number 12 died, and it is rather surprising that but 9 of these 164 cases, or 5.48 per cent., had had one or more *epileptic seizures*.

A much more common complication of the retained missile was *abscess*. Tuffier and Guillain presented their statistics of 4262 cases which had been previously operated upon and subsequently distributed to various neurological centers. Of this series, 770 patients had hemiplegias, 206 monoplegias and 200 aphasias. In a total of 6664 cases of gunshot wounds, the late complications are tabulated as follows:

	Cases.	Percentage.
Partial or generalized epileptic seizures	676	10.14
Late cerebral abscess	91	1.41
Late meningitis	32	0.48
Late cerebral hernia	54	0.81
Mortality	83	1.24
Sudden deaths	1	

The general impression seemed to prevail at these conferences that secondary or late complications of craniocerebral wounds are much less frequent than hitherto supposed, and that the outlook for recovery is more hopeful since the adoption of more rational and better methods of treatment. The following conclusions were adopted:

1. If secondary complications of cerebral wounds are relatively frequent, later infectious complications are much rarer than supposed.

2. The consecutive organic troubles in brain wounds, *i. e.*, hemiplegia, monoplegia, aphasia, visceral troubles, etc., frequently have a tendency to disappear. Their treatment comes under the domain of neurology.

3. The later epileptic seizures of Jacksonian character can be benefited by the removal of the compressive cause, foreign bodies, bone fragments, etc. It is not of much use to operate for one or two isolated attacks of Jacksonian epilepsy, for they may be due to encephalitis, capable of resolution, and on which operation would have no influence. Epileptic seizures, outside of cases where a foreign body or a bone fragment exists, do not call for any new surgical operation. Lumbar punctures, in case of hypertension of the cerebrospinal fluid, controlled by a manometer may have a good result.

4. Late cerebral abscesses diagnosed and differentiated from non-suppurative encephalitis ought to be operated upon after accurate clinical localization made by the surgeon and the neurologist. After exploratory puncture, and without destroying the protective adhesions, the abscess should be opened and its sterilization followed bacteriologically.

5. Late localized meningitis and encysted abscesses of the meninges must be operated upon.

6. Treatment of generalized meningitis is most frequently ineffective. Repeated lumbar punctures appear to be the most rational form of treatment.

7. Cerebral herniæ with abscess are to be operated upon and the abscess drained. It seems preferable to abstain from lumbar puncture at the first acute feverish stage of certain cerebral herniæ to avoid possible diffusion of a localized infection. When the initial infection has subsided, lumbar puncture, by diminishing the intracranial pressure, may favor the reduction of these herniæ. The resection of herniæ is an operation only justified in case of local necrosis or of meningocele.

8. Intracerebral foreign bodies causing attacks of encephalitis or epileptic seizures should be extracted. Foreign bodies that cause no trouble should be left alone.

9. Cranioplasty is indicated from the esthetic point of view, especially in losses of substance of the frontal region. From the therapeutic point of view it is only justified in cases where the extension of the scar is the cause of complications observed. From the prophylactic viewpoint, the danger of an ulterior cranial accident in the trephined region may be an operative indication. In any case there should be assurance that there are no contra-indications to intervention on the score of nervous trouble, chemical or cytologic modification in the cerebrospinal fluid, or papillary stasis.

10. Early treatment and methodical disinfection, with primary sterilization of the intracerebral traumatized area, is the best prophylactic treatment of secondary or late infective complications of head wounds.

Cranioplasty. Since the outbreak of the war there have been numerous contributions to the question of how best to repair defects of the skull. This perhaps is natural, since the opportunities for performing this operation have increased in untold numbers. There is a great deal of sameness in the articles and many an author writes as though the field had before the war been unexplored, unaware perhaps that many an opportunity had been offered from the casualties of civilian life.

Inasmuch as the principles in the technic of cranioplasty are so well understood, I will touch only briefly and upon the essential points as they have been emphasized in the contributions of the past year. Gilmour,¹⁰ of Toronto, lays down the following fundamental principles: (1) The operation should be deferred three months after the wound has entirely healed; (2) the graft should be autogenous, preferably the crest of the tibia; (3) the periosteum of both the host and grafted bones should be retained, as well as the endostium of the graft. (The latter, however, I do not regard as essential.) (4) close apposition and immobilization of the graft.

In the elaboration of the *technic*, he makes the following suggestion: The region should be exposed by a horse-shoe incision which extends

¹⁰ Surgery, Gynecology and Obstetrics, September, 1918, vol. xxvii.

down to, but does not include, the galea aponeurotica. The latter and the pericranium are opened by a longitudinal incision which extends at least one and a half inches to one or the other side of the opening. Then follows the usual preparation of the defect; the removal of the scar from the dura, the freedom of adhesions from the margin of the defect, perhaps reflecting the adherent dura and substituting a graft of fascia lata with its fat covering toward the cortex, the bevelling of the bony margin until the cancellous and vascular diploe are exposed, drilling the margin with two or three holes through which to thread the catgut for immobilization of the graft. The latter is taken from the inner surface of the tibia for its entire width, one-eighth inch thick, and transferred immediately to its bed with the periosteum turned toward the dura mater to prevent the growth of exostoses toward the brain. The graft is immobilized by the catgut strands that have been threaded through the holes already drilled in the margins of the bony defect.

Speaking of the condition of the patient with a cranial defect, Gilmour portrays a picture which I should say was by no means constant. The patient's cerebration, he says, is slow, the memory poor. A constant symptom is extreme depression, associated with fear, probably due to an apprehension of further injury. The patient appears drowsy and lacks initiative, headache is always present, intermittent or continuous, and is aggravated by movement. Occasionally vomiting may occur, especially during exercise, and is apt to be followed by dizziness. In every one of his cases there was an abnormal contraction of the color fields, sometimes irregular and interlacing, at other times appearing in the form of complete color blindness. Blurring of vision and slight choked disk he found quite common.

As I said before, this picture does not conform to that which I have seen in patients with cranial defect, at least with no such degree of uniformity. To be sure, one symptom or another and in various combinations I have observed, but I should not say that headache was a constant symptom, nor loss of memory, slow cerebration and lack of initiative. As to the changes in the color fields, I must acknowledge this is a revelation if, as Gilmour says, it is observed in every case. In 50 consecutive cases in my own clinic there were no alterations in the color fields at all. As the afflictions of Gilmour's patients are manifold, so is the operation extraordinarily effective. From being depressed, the patient becomes bright and optimistic, the headaches vanish, the memory improves, the blurring of vision disappears and the color fields increase.

De Martel believes there is seldom any imperative indication for this operation. The principal indication, however, is for the purpose of protecting the brain when the defect is large and when a blow upon the exposed region might have serious consequences. It is also indicated when the defect is situated in the frontal region and entails an unsightly deformity. The operation is clearly contra-indicated when there are signs of some slight hypertension and under no circumstances should it be practiced in the attempt to forcibly reduce a cerebral hernia. In those cases in which there are large defects and in which the skin is often

replaced by cicatricial tissue, one should bear in mind that no matter what the material used, it is necessary to cover it with reasonably supple and properly nourished integuments. The thin scar tissue does not meet these requirements and unless by plastic methods the defect, caused by the removal of the scar tissue, can be closed, the operation should not be undertaken.

Our attention is called to certain *modifications in the technic*, such as that of Le Fur,¹¹ which to me seem unnecessarily complicated. The graft as outlined has a pedicle and includes the entire thickness of the skull. It is then split in two with a chisel, working from the margins of the graft toward that of the defect. At the latter the section of the graft is made so thin as to enable it to be deflected and turned down over the defect, with the periosteum in contact with the dura. The pericranium is dissected free around the margin of the defect so that the edge of the graft may be inserted between it and the underlying skull. The graft is secured in place with a few interrupted catgut sutures.

In 37 cases operated upon by these methods, including a number in which the defect was 7 cm. in diameter, there was but one death as the result of infection three weeks after the operation. No doubt the results of this method were entirely satisfactory, but since simpler methods of employing isolated grafts, either of bone or cartilage, are so uniformly successful, the technic of Le Fur does not recommend itself to us as worthy of endorsement.

I have been rather surprised to see what satisfactory results have been obtained in the *repair of defects in the skull by the use of plates of bone taken from the skull of a cadaver*. Sicard¹² reports a series of 85 cases without a death, in which the results have been both reliable and enduring. This method, I presume, would be applicable chiefly in times of war when the number of killed provided ample opportunity for securing fresh specimens from healthy subjects. Even under these circumstances, uniformity of success in the use of a graft of tissue from one individual to another cannot but arouse one's attention. As already indicated, my preference in the repair of cranial defects has been for the use of bone, rather than a cartilage graft, the bone graft being taken from the outer table of the patient's skull. While I have had an opportunity to use cartilaginous grafts recently in the treatment of overseas patients, sufficient time has not yet elapsed to enable me to make a comparison between the ultimate result of the cartilage and bone graft. Thus far, the cartilage grafts have healed in without complications, but consolidation does not take place as quickly as when the graft is of bone.

At a recent meeting of the Société de Neurologie de Paris¹³ there was a discussion on the subject of cranioplasty which included the following questions:

1. The *time limit* at which cranioplasty can with certainty be said to be of protective value. Bionet insisted upon four months, while Villaret was satisfied with a few weeks, if a metal substitute be used.

¹¹ Presse méd., Paris, 1918, xxvi, 153.

¹² Bulletin de l'Académie de médecine, Paris, April 23, 1918.

¹³ Revue de Neurologie, March and April, 1918.

2. The *percentage* of cases in which *complete obliteration of the defect* is obtained.

Villaret reported 89 per cent. with cartilaginous grafts.

Descomps reported 57 per cent. with osseous grafts.

“ “ 42 per cent. with cartilaginous grafts.

“ “ 50 per cent. with metal plates.

Sicard and Bionet maintained that better and more permanent results were obtained with osseous grafts, and with them I am heartily in accord.

Descomps reported re-absorption or displacement of the graft in 29 per cent. of osseous, and 42 per cent. of cartilaginous grafts; Meuriot, l'Hermitte and Platou reported complete obliteration of the defect in 90 per cent. of chondroplasties.

3. *Proportion of recoveries*, objective and subjective. Villaret stated that, except for the disappearance of certain cerebral reactions, all the subjective symptoms remain unchanged. Except in cases of infection or of compression from hematoma, there were no changes in the paralytic, spastic, epileptic, visual, aural and aphasic symptoms. These observations were confirmed by Chiray and by Tinel. Sicard, on the other hand, made rather extravagant claims: Recoveries, 25 per cent.; improvement, 30 per cent.; persistence of subjective symptoms, 45 per cent., and persistence of paralytic, spastic and epileptic symptoms, 50 per cent. Descomps admitted that in 40 per cent., epileptic symptoms were provoked rather than relieved by the operation.

4. As to the *eventual removal of the graft*, where symptoms were aggravated, there was a general consensus of opinion that the necessity for this was very rare.

5. There was a divergence of opinion as to the *advantages of cranioplasty for cerebral hernia*. Both Tinel and Descomps advised a late cranioplasty, after a course of preliminary treatment.

Carrière, on the basis of extensive clinical material, expressed preference for metal grafts from the standpoint both of immediate and permanent results, with the following qualifications: Commercial aluminum often shows a tendency to become absorbed; gold is not always tolerated; it is advisable to use some alloy less absorbent than aluminum; as heteroplastic osseous flaps often become absorbed, it is better to use the autoplastic graft; the value of chondroplasty has not yet been definitely established.

Definite conclusions as to *end-results* are premature at this time, since even after six to twelve months the graft may be absorbed. The best results should be expected in selected cases from autoplastic grafts of the tibia with its periosteum.

According to Carrière, *cranioplasty* is *contra-indicated* in Jacksonian epilepsy, a complication in 60 per cent. of the cases. Paralytic manifestations are not improved. Cephalalgia, varying in intensity and location, is the most persistent symptom in 92 per cent.; vertigo is permanent in 81 per cent.; nausea in 20 per cent.; asthenia in 72 per cent.; subjective disturbance of sight is present in 22 per cent., and of hearing in 75 per cent.

Hypertension of the cerebrospinal fluid, as well as chemical and cyto-

logical changes, indicate a constant meningeal reaction, though latent in some few instances. Cranioplasty is contra-indicated when the tension is below 50 (Claude manometer); when there are positive alterations, both quantitative and qualitative, to the nystagmus test; when there is an albumin content and lymphocytosis in the spinal fluid. Clinically, cranioplasty is contra-indicated in cerebral hernia, when the symptoms are exaggerated by pressure; when the patient notices some relation between the symptoms and the degree of tension at the site of the hernia, and when moderate pressure over the defect fails to allay the symptoms.

The *conclusions* contained in the report by George Guillain, professeur agrégé à la Faculté de la médecine de Paris, were adopted by the assemblée as follows:

Before a cranioplasty is done, the patient should be systematically examined from the neurologic standpoint. Cranioplasty is contra-indicated when (1) there is present any nervous trouble connected with modifications in the circulation in the brain; (2) if the cerebrospinal fluid is not absolutely normal as to tension, chloride and albumin contents, and if it contains leukocytes; (3) if ophthalmoscopic examination discloses the existence of a papillary stasis or choked disk; (4) if the patient shows partial or general epileptic phenomena; (5) if the Roentgen rays reveal an intracranial projectile; (6) if the patient has exhibited serious meningeal symptoms. In those cases in which the cicatrix seems to be the cause of the nervous symptoms, it is wise, before undertaking any plastic operation, to make sure that these symptoms will disappear on the application of a protective external plate.

From a medico-legal-military point of view, Guillain concludes that in gunshot wounds of the head, whether considering the question of cranioplasty or of retirement, the decision should not be based on the size of the defect, whether it is above or below the dimensions of a silver dollar (five lire piece). Irrespective of the size of the defect or of the protective value of a cranioplasty, the decision should be based only on the extent of cerebral disorder. In a medico-military sense, loss of cerebral substance alone should be considered, whether or not a cranioplasty has been performed. Even extensive loss of cerebral substance, either with or without cranioplasty, does not of itself guarantee a retiring pension.

P. Marie, on the basis of a large number of cranial injuries observed at La Salpêtrière, states that only exceptionally does the material used show the resistance equivalent to that of the cranium. He finds cartilaginous the most serviceable, although he usually regards the operation as inadvisable. Numerous other authors, especially Soquès, believe that cranioplasty produces mechanical conditions favorable for hypertension and epilepsy; an estimated percentage (40 per cent.) of epilepsies attributable to autoplasty is not an exaggeration; although, according to Babinski, a certain percentage of such crises are hysterical, and can be provoked and controlled by suggestion. Meuriot and l'Hermitte, on the study of 7 cases, commented upon the persistence and aggravation of subjective symptoms, such as vertigo, inattention and buzzing in

the ears. The operation does not benefit the paralytic and spastic symptoms nor the sensory disturbances. They did observe a better morale, however, after closure, though late, of the frontal defects.

Andre Thomas is more optimistic. Above all, he believes in selecting suitable cases. In fact, he thinks that favorable results have already been noted, both from an esthetic and a protective point of view. It is possible that the unfavorable results may be attributed to faulty technic, such, for example, as placing a cartilaginous graft between the cranium and the dura. In the operated cases, while he saw no aggravation of the objective symptoms, there was little improvement in any of the focal symptoms, and sometimes epilepsy appeared or developed or, if present already, was aggravated. As to the question of pensions, he advises postponing a decision as long as possible, since unexpected improvement is not exceptional. According to Villaret, the remote results depend upon the lesions found at operation, upon the presence or absence of foreign bodies (projectiles). Bionet estimates the disability, after a cranial injury with bone defect, at 30 or 40 per cent., and recommends increased indemnity when there is loss of cerebral substances.

Finally, Dide and Claude maintained that in cranial defects with little loss of substance, cranioplasty is always contra-indicated: it is physiologically useless as well as psychologically obnoxious, and is a possible factor in the persistence of subjective symptoms. In cases with larger defects, they believe cranioplasty to be more objectionable than useful, and prefer the use of some adjustable protectives. Functionally, cranioplasty often produces a neurasthenic syndrome.

Intracranial Trauma and Decompression. With some hesitation, I refer again to this much-hackneyed question. It has been discussed so much in these columns from year to year that I had almost concluded the final word had been said. But Payne¹⁴ tells us he is surprised at the indifference many doctors show to this question in connection with severe head injuries and so he feels it a duty to admonish us of our shortcomings. First of all, he tells us we must operate early if at all and not wait for the stage of medullary collapse. With this we will agree. To determine when the operation should be performed, the pulse-rate and blood-pressure should be recorded every thirty minutes, the eyegrounds examined every hour and the spinal pressure observed one or more times. Now for the indications: (1) When a pulse of 80 drops to 60 we should strongly consider a relief of the intracranial pressure. (2) A drop to 55 or 50, with retinal edema and a rise of blood and spinal pressure is a positive indication for operation. (3) One need not wait, however, for the appearance of all the cardinal signs of intracranial pressure. For instance, a pulse of 50 with "partial optical edema" (whatever this may indicate) or a pulse of 50 with a rise of 20 mm. in spinal pressure or a slow pulse with a rising blood-pressure plus optical edema or increased spinal pressure are entirely sufficient to warrant operation. Following these prescribed indications, Payne operated upon 29 cases with a percentage recovery of 75.86. This is an excellent showing, but it leaves

¹⁴ Surgery, Gynecology and Obstetrics, Sept., 1918, vol. xxvii.

one in doubt as to how many of these cases might have recovered without operation.

Highly as I regard Payne's attainments as a surgeon, I must take issue with him as to the emphasis he lays upon certain objective findings as a guide to the necessity of operation. To my way of thinking, one must take into consideration the whole clinical picture and not the few effects of pressure upon which alone Payne relies. The state of consciousness, the whole Cheyne-Stokes phenomenon, including the pulse, respiration, motor activity, reflexes, mental excitation or stupor, etc., should be taken into consideration. Many a patient with a pulse of 50 will recover without operation, in many cases the blood-pressure will not be appreciably raised and one never knows what may have been the pressure before the accident. The papillo-edema is by no means a constant sign, and, when it does develop, is very much more apt to be a late than an early sign. For these reasons particularly I should caution the inexperienced not to place too much reliance alone upon the pulse, blood-pressure and appearance of the eyegrounds.

This rather threadbare question is also discussed by Sieber¹⁵ who also reviews somewhat at length the well-known neurological responses to the effects of pressure upon the cerebral circulation and vasomotor centers.

There are two points in this contribution on which emphasis is laid. (1) That frequent blood-pressure and pulse-rate observations not only should be made to determine the degree of intracranial pressure, but may be utilized as indications for or against the advisability of relieving the pressure. (2) That intracranial pressure should be relieved before the advanced stage of medullary compression and edema is reached. With these general principles no one, of course, would take exception, other than to say that one should not depend alone upon blood-pressure and pulse-rate observations in selecting the time for operation, but must be guided also by the results of examination of the eyegrounds and by a number of other clinical findings, which I have already enumerated as of as much importance as the blood-pressure and pulse-rate.

Applying his rules of conduct to all cases of intracranial trauma, Sieber finds that they are readily subdivided into three groups: In group one are the milder cases, in which there is no evidence of intracranial pressure. In group two are the cases presenting signs of definite increase in intracranial pressure. In group three are those cases presenting symptoms of advanced medullary compression, with evidence of severe laceration or contusion of the brain. There are, of course, no indications for operation in the first group, at least for the relief of intracranial pressure, and in the third group the high mortality, 87 per cent., as shown in Sieber's records, shows the fatality of surgical intervention. The large number of cases, therefore, in which a subtemporal decompression is indicated fall naturally into the intermediate group, or group two. In this group, Sieber recommends that one should not wait for the appearance of any certain degree of cerebral compression as an indication

¹⁵ *Annals of Surgery*, vol. lxxvii, No. 1, p. 51.

of operative intervention. "Whenever a case of head injury," he says, "shows a progressive increase in arterial pressure and a corresponding decrease of pulse-rate, it is not only advisable, but imperative that immediate relief of intracranial pressure be instituted." If the pressure be not relieved before the dangerous stage of medullary compression is reached, so much cerebral damage may have been produced that recovery is doubtful. His results, however, can hardly be said to offer a very substantial endorsement of the advantage of decompression in intracranial trauma, and if we should add to them twelve operations from group three, with a mortality of 75 per cent., the situation is still more unpromising.

The classification which Sieber has adopted corresponds practically to that of which I long have been an advocate, in an attempt to encourage a neurological grouping of cases of intracranial trauma when considering the question of operation. There is no doubt in my mind that it is absolutely unjustifiable to operate in group one, and this I know is constantly done by those who resort to decompression as a routine. And it is useless to operate in group three, that is, in the advanced stage of medullary compression when the vasomotor mechanism has collapsed. It is in the intermediate group, therefore, and in only a selected number of these, that there will be found cases in which operation may be intelligently resorted to with a reasonable hope of shortening the convalescence, possibly lessening the frequency of post-traumatic sequellæ and saving a certain number of lives.

Finally, I refer to the recommendation of Espejo,¹⁶ who tells us that in Sharpe's Clinic, "only those patients are operated upon who have recovered from shock, with a pulse-rate below 120, the spinal manometer registering 15 mm. of pressure or over, and the ophthalmoscope revealing partial or complete obscuration of the ocular disks."

The discussion upon the indications for operation in brain injuries follows the report of the case in which, six days after fracture of the skull, with signs of concussion, the child developed, while apparently on the road to recovery, signs of cortical irritation, with contractions of the left half of the face and neck, and complete flaccid paralysis of the left arm and leg. A right subtemporal decompression was performed and, upon opening the dura, there were no signs of any increase of intracranial pressure, only a suggestion of cortical edema.

It is not altogether clear to the reviewer what the connection is between the indications for operation as above outlined and the operative findings in the particular case reported. There were no signs of intracranial tension or hemorrhage, and it is more than likely that the case would have recovered without operative intervention.

Cerebral Edema. To one who has frequently viewed the brain surface on the operating table, the condition which one might call cerebral edema is not unfamiliar. There are a number of underlying factors, such as epilepsy, toxemias, as in uremia, and acute alcoholism, trauma, etc., and to these Rawling¹⁷ adds another from his experience in the East

¹⁶ Journal of the American Medical Association, May 4, 1918.

¹⁷ British Medical Journal, May 4, 1918.

during the War. There were hundreds of patients who presented a clinical picture, due, he believed, to intracranial pressure, where typhoid fever, malaria and the like were readily excluded, and by a process of exclusion were thought to be suffering from "heat effects."

The symptoms from which the patients were suffering included the following: (1) Headache. This was usually persistent, worse at the onset of the attack, referred chiefly to the frontal region, and complained of more at night than in the morning. (2) Mental conditions. The patients were listless, disinclined to leave the ward, and this only after the heat of the day. (3) Vomiting occasionally, but more frequently the nausea of the sick headache type. (4) Photophobia was marked, but there was no papillo-edema. (5) Pulse rather slow and blood-pressure rather elevated. (6) Reflexes were exaggerated. Epileptiform convulsions were observed in a large percentage of cases. They were of variable frequency and severity, on some occasions exceedingly violent and developing in increasing severity for a period of three hours. While the symptoms were believed to be due to increased intracranial pressure, they were not relieved, and in some cases exaggerated, by lumbar puncture, even though a large quantity of fluid was removed. On the other hand, almost immediate relief followed a subtemporal decompression, and at the operation there was always an excess of cerebrospinal fluid.

Discussing in a general way the question of cerebral edema, Rawling advances as an hypothesis some alteration in the walls of the veins whereby the absorption of the cerebrospinal fluid is more or less interfered with. This hypothesis he bases on the fact that the pressure of the cerebrospinal fluid is a little above that of the venous pressure, and that under normal conditions the major portion of the fluid is absorbed through venous channels. Rawling's description of what is implied by the term "cerebral edema" as we see it on the operating table is so well portrayed that I quote from the original:

"When the dura mater is incised, in an operation for subtemporal decompression carried out for the conditions under discussion, clear cerebrospinal fluid at once escapes from the subdural space, often spurting out as if under considerable pressure. Under normal conditions there is no fluid in the subdural space, and none escapes when the subdural space is exposed. In the event, however, of considerable excess, the cerebrospinal fluid which normally occupies the subarachnoid space is forced by the increasing pressure between the cells of the arachnoid membrane into the subdural space. This escape of fluid from the subarachnoid space is not problematical. It can be seen in any typical case of cerebral edema when the dura mater is incised. The arachnoid presents a 'weeping' appearance, the tears collecting into rivulets and running away at the lower part of the exposed area. In relation to the cortical veins, lying in the cerebral sulci and embedded in the subarachnoid tissue, little rivers of fluid can be seen with the naked eye, fluid exuding therefrom and contributing to the general pool that collects below. The brain presents a boggy appearance, and the general surface cortical edema can be very prettily demonstrated by applying gentle pressure with a sponge, the excess fluid being momentarily squeezed

aside, to return as a wave so soon as the pressure is removed. The surface of the brain looks like a very wet sponge.

This excess fluid, seen at the operation, will continue to run away during the sewing up of the wound, and that it continues to run away from the surface of the brain into the subtemporal tissues, both during the healing process and subsequently, is shown by the frequent presence in the temporal region of a fluid swelling; it demonstrates the success of the operation, being the proof that the intracranial pressure has been relieved by the draining away of the fluid excess. That this swelling is a fluid collection can be proved directly both by transillumination and by aspiration, and indirectly by means of lumbar puncture. I have frequently carried out lumbar puncture when it seemed advisable to lessen the degree of temporal swelling, the removal of fluid being followed by considerable diminution in the size and tenseness of the swelling. In the more favorable cases, such as those mentioned in this paper, the swelling is never very marked, and it gradually recedes until eventually the temporal region lies flush with the surrounding area."

LUMBAR PUNCTURE AND INTRACRANIAL TRAUMA. In the military hospital of Hoogstaede, Belgium, under the direction of Professor Williams, F. Albert¹⁸ studied the effects of lumbar puncture in intracranial trauma and meningeal lesions. His observations confirm the value of lumbar puncture, both as a diagnostic and therapeutic agent. After illustrating the details in 15 selected cases, Albert draws the following conclusions:

"1. In all doubtful cases of fracture of the skull or of intrameningeal hemorrhage, lumbar puncture, by the character of the cephalorachidian liquid removed, will determine at once the diagnosis.

2. Lumbar puncture is capable of determining with certainty the differential diagnosis between simple congestion and irritation as distinguished from local compression of a latent zone of the cerebral cortex.

3. Lumbar puncture constitutes an infallible means of distinguishing simple cerebral hernia from the symptomatic cerebral hernia of abscess of the brain or of encephalitis. Each time that the hernia does not subside completely after lumbar puncture, the inference is conclusive that there is present a foyer of encephalic infection.

4. Every case of cerebral concussion and congestion is always accompanied by excessive secretion of cephalorachidian liquid producing phenomena of congestion. These reveal themselves by the ordinary symptoms of compression. In such cases lumbar puncture is the treatment especially indicated, since it removes at the same time the effect and the cause.

5. Lumbar puncture is the only really efficient treatment of fracture of the base of the skull.

6. All cases of irritation of the cortex and of Jacksonian epilepsy to which no apparent external cause can be given are influenced favorably by lumbar puncture; though it has no direct effect upon the local cause, it may, by diminishing vascular tension, render the local cause inefficient.

¹⁸ Lyon Chirurgical, April, 1918, xv, p. 328.

Every time that the puncture is without effect, one may be sure that there exists a gross cause of irritation and an explorative craniectomy should be done.

7. Cerebral hernia may always be made to recede and disappear completely by a successive series of lumbar punctures, if these are resorted to early, before the hernia has contracted adhesions, and especially before it has become fleshy and irreducible. Once such a hernia has been reduced, the author recommends, in order to prevent return, that a secondary suture of the wound should be made with, if possible, immediate cranioplasty.

8. Repeated lumbar puncture to a full degree is the treatment of choice possessing real value in cases of post-traumatic meningitis, even in those due to staphylococcic and streptococcic infection. In such cases of infection advantage will be obtained by association of the lumbar puncture with intrarachidian serotherapy followed by decubitus with the head lowered."

LUMBAR PUNCTURE AND HEADACHE. The occurrence of headache after lumbar puncture is a well-known phenomenon. An attempt at explanation has provoked many discussions, and recently MacRobert¹⁹ has evolved a theory which attributes the headache to certain mechanical conditions affected by posture. The line of reasoning about to be described depends upon the premise that headache comes on when the patient sits up and disappears when the patient lies down. While there may be some merit in the author's speculations, unfortunately his premise is by no means an invariable condition. I have seen a number of patients, upon whom I have performed a lumbar puncture and who were instructed to keep to their bed afterward, complain bitterly of headache, and I am sure that this has been the experience of others. MacRobert maintains, in the first instance, that the puncture opening in the dura is not closed after the withdrawal of the needle so that the fluid continues to drain from the cerebrospinal sac. The amount of fluid collected at the time of puncture, therefore, is no criterion of the amount which may eventually escape. This much I believe to be true. And I have seen in one instance an area of edema develop in the subcutaneous tissue about the site of the puncture which unquestionably bespoke continuous drainage of fluid. MacRobert refers to a case in which he was obliged to suddenly withdraw the needle, without collecting fluid, and the patient developed a severe headache lasting eight days.

The author's explanation of how this drainage of fluid operates in the production of headache is as follows: The cerebrospinal fluid contained in a closed sac forms a pad for the brain and spinal cord. At the base of the brain this pad becomes a veritable cushion or water-bed. When the fluid leaks away through a hole in the lower end of this sac, the base of the brain loses its supporting fluid cushion. We may expect this support to remain absent until the puncture hole heals and the fluid again fills and distends the sac sufficiently to reestablish this water-bed.

¹⁹ Journal of the American Medical Association, May 11, 1918.

The loss of this supporting basal cushion may be regarded as the secondary causative factor in the production of the headache. How does this produce pain? A headache, which, let us recall, comes on when a patient sits up, and disappears when he lies down, must obviously be mechanically produced. Pressure of the meninges by the brain weight, against the irregular bony surface of the base of the skull, which would ensue when the patient sits up, in the absence of the basal fluid cushion, might be considered to be sufficient cause for headache. However, another explanation appeals to him as more aptly applying to the situation.

A mechanical accident following spinal puncture has caused sudden death in certain brain tumors, and other intracranial conditions accompanied by increased intracranial pressure. The withdrawal of fluid deprived the base of the brain of support, and allowed such forcible descent of the pons on the clivus of the occipital bone that prolapse of the medulla through the foramen magnum occurred. In the average normal case, if the supporting fluid cushion is completely lost by continuous leakage through a patent puncture-hole, we may expect the pressure of the brain weight transmitted through the pons to the clivus, when the patient sits up, to be considerable.

The basilar plexus on the clivus of the occipital bone is formed by an extensive anastomosis of flat venous plexuses. It is connected on either side with the cavernous and inferior petrosal sinuses, and with the neighboring blood channels (Sobotta-McMurrich). The other venous channels that drain the cranial cavity at the base are rigid, inelastic tubes, and they are thus safe from closure by pressure. The basilar veins differ in this respect of security from closure. They depend on the cushion of the cerebrospinal fluid to keep off the pressure of the pons, which is directly above. When the patient sits up, and the cushion of fluid is absent, the weight of a good part of the brain is suddenly imparted through the pons to this communicating plexus. The blood about to leave the skull is impeded, and forced to turn back and travel by other crowded pathways. The resulting congestion causes a sudden rise of venous pressure.

The sudden onset of severe headache when the patient sits up can now be understood as due to the sudden intracranial pressure due to the rise of pressure in the cerebral veins; its entire relief, when the patient lies down, as due to the fall of pressure when the weight is removed from the veins on the clivus. In the course of a week the puncture hole heals, the fluid is rapidly made in sufficient quantity to fill and distend the entire sac, and the integrity of the brain cushion or water-bed is reëstablished. The headache, which was a purely mechanical affair dependent on the loss of that cushion, is gone.

SUBOCCIPITAL PUNCTURE. In my review of last year, I overlooked a contribution by Anton Scheimeden²⁰ on the subject of suboccipital puncture. We are familiar with Scheimeden's original proposal of puncture of the corpus callosum for the relief of intracranial compression. This

²⁰ München. med. Wehnschr., 1917, No. 6.

operation I have practiced a number of times but in my experience the results have been disappointing in that the effects of the operation have been, in most instances, of only transitory duration. For some reason or other, the communication with the dilated ventricle becomes closed, and, with it, the avenue of escape for the pent-up cerebrospinal fluid. Since the outbreak of the war, Payr has extended the indications for callosal puncture to lesions incident to gunshot wounds and has practiced callosal puncture some fifty times in contusions of the brain, traumatic encephalitis and meningitis.

In his more recent contributions, Scheimeden speaks of suboccipital puncture as a permanent means of reducing pressure and refers to the experience of Druff who found that when the atlanto-occipital membrane was removed, it was impossible to kill the animal no matter how great the increase in intracranial pressure. The operation, as recommended, is carried out under local anesthesia through an incision 8 cm. long, beginning two finger breadths below the external occipital protuberance. Under conditions of increased pressure, the atlanto-occipital ligament was found to bulge, and, on puncture, the fluid escaped in a jet. A cannula is then introduced, first into the basal cistern and then into the fourth ventricle. Thus a track is established whereby the cerebrospinal fluid may drain into the intramuscular and subcutaneous tissues. The operation is indicated in hydrocephalus, brain tumors, epilepsy, serous meningitis, and in those severe forms of hemierania with Quinke's edema.

EXPLORATORY PUNCTURE OF THE BRAIN. The employment of the exploring needle has been advocated at one time or another in various cavities of the body, but in most instances, with notable exceptions as in pulmonary abscess, the exploring needle has given way to the exploratory incision. The use of the exploring needle in the brain had its vogue in times past, and it was not very long ago that an attempt was made unsuccessfully to popularize exploratory puncture for brain tumor. But as a means of evacuating the ventricles, the needle or cannula serves a very definite and useful purpose.

Villandre²¹ resorts to *cerebral puncture* in the examination of cranial wounds for locating cysts which might be communicating with the lateral ventricle; or for the purpose of locating a fragment of bone or metal pictured in a skiagram; or for determining the presence of, and eventually treating, superficial or deep abscesses; or for exploring the ventricular cavity and judging the quality and tension of the cerebrospinal fluid.

Very often, in the repair of a wound, brain cysts or sometimes ventricular diverticula form, the latter as a sequel of cerebral hernia involving the ventricular cavity. By means of an exploratory puncture, such a condition can be determined. The importance of such information is apparent since such diverticulæ invite a risk of a postoperative ventricular fistula, which may readily become infected. In many cases, too, the presence of a ventricular diverticulum is a contra-indication to cranioplasty.

²¹ Jour. de Chir., May, 1918.

In the removal of foreign bodies, after localization with the x-ray, the location of the object may be fixed by the needle and the latter serve as a reliable guide in attempts at removal.

Villandre refers to his use of the needle in exploring for *cerebral abscesses*. And he has evacuated abscesses by repeated puncture and drainage, by which, with the aid of autovaccination, he claims to have had excellent results. This seems to me a rather questionable mode of procedure.

Falconi²² refers to the use of trepano-puncture as a means of introducing *tetanus antitoxin* and as a diagnostic measure in *cerebrospinal meningitis*. Its greatest service, he says, is in the management of ventricular hypertension and refers to Van Bramaan's experience in 51 cases, which include 27 of tumor, 18 of hydrocephalus and 6 of epilepsy. His technic of puncture of the ventricle through the corpus callosum is as follows: An incision is made 3 cm. in length, one finger breadth posterior to the coronal suture and 15 mm. from the median line; the bone is trephined, the dura incised, and a silver sound is introduced between the dura and the hemisphere to the falx and then along the latter through the corpus callosum; after withdrawing 15 to 20 cm. of cerebrospinal fluid, the incision is closed. He discusses also the employment of ventricular puncture in the treatment of *hydrocephalus*, especially when the absence of hypertension on lumbar puncture shows the foramen of Magendie to be impervious.

Villandre²³ determined the exact topography of the ventricle in the cadaver. He made radiographic pictures of the cranial cavity by injecting the lateral ventricles with substances impermeable to the x-rays. It appears that the ventricles wind around the Sylvian fossa, the anterior horn dividing in the plane of the so-called Mme. Dejerine's poles (a horizontal plane passing through the frontal and occipital poles of the brain) at about 50 mm. from the external surface; the two ventricles being separated from each other by a distance of about 40 mm. In order to reach the extreme anterior horn of the ventricle, one should make a trephine opening 10 to 12 mm. in diameter, the center of which corresponds to a point at about 60 mm. above the glabella and 20 mm. from the median line; the needle is introduced horizontally on a level with the plane of the poles and parallel to the median sagittal plane; and the horn of the ventricle is reached at a depth of 50 to 55 mm. Introducing the needle less than 50 mm. from the glabella one runs the risk of entering the frontal sinus; on the other hand, for esthetic reasons, it is desirable to go up as far as the hair line, when the needle should be directed obliquely downward and backward. The posterior horn of the ventricle can be reached by making an opening at a level with the parieto-occipital suture, 30 mm. from the median line; the needle is inserted parallel to the plane of the ventricle and to a depth of 45 to 50 mm. to the median sagittal pole.

Meningeal Hemorrhage in the Newborn. From time to time we have commented upon the various methods of treating this condition, more

²² Riforma Medica, 1918, xxiv, 655.

²³ Loc. cit.

particularly with reference to a craniotomy. The latter we have regarded as questionable because of the fact that the hemorrhage is usually diffusely distributed over both hemispheres, and any method of dealing with the hemorrhage over but one hemisphere does not adequately meet the conditions. Latterly a number of experiences have been published that tell of the benefits to be derived from lumbar puncture. Under this, mention may be made of a report by Brady²⁴ whose experience included 9 cases. Four of these died in the early months after birth, one having been submitted to craniotomy; death occurred twelve hours later and a large hemorrhage was found at necropsy at the base of the brain. Three patients were treated by lumbar puncture, two making a complete recovery; in one, 30 c.c. were removed; and in another, at various times, 240 c.c. Not only did these cases survive, but there was no evidence of Little's disease or spasticity later. Brady calls attention to the fact that lumbar puncture will be of greater value in the subtentorial than in the pretentorial cases since the hemorrhage above the tentorium is mostly subdural, and the blood, therefore, does not readily find itself in the subarachnoid space of the dural sac in the spinal canal. Whether or not a craniotomy is contemplated in the pretentorial cases, a lumbar puncture should be resorted to in all cases of obscure illness in the newborn infant with signs of increased intracranial tension.

Brindeau's²⁵ experience included four operations, two of which were for intracranial hemorrhage of the newborn and two for fracture. The technic for these so-called "tin plate" fractures is comparatively simple as the depression can be corrected by a very small opening. I have found that through a small drill hole a small dural separator can be introduced, and with proper manipulation the fragments are elevated to their proper relationships. In the two fracture cases operated upon by Brindeau, the patients recovered, but both cases with intracranial hemorrhage died. Either the operation was performed too late or the autopsy revealed irreparable lesions. Brindeau exposed the seat of hemorrhage with an inverted U-shaped flap, with its apex just below the parietal protuberance. In 15 operations for intracranial hemorrhage which the author collected from literature, there were only 4 recoveries.

In this connection I may allude to a very exhaustive study of this subject in articles covering 132 pages by Hedren.²⁶ His article is very comprehensive and deals with the subject chiefly from the standpoint of the cause, symptoms and medicolegal aspects. In a series of 700 autopsies, he found intracranial hemorrhage in 9.28 per cent. In 84 per cent. of these, the hemorrhage was meningeal in origin, and, in the remainder, cerebral. In 42 selected cases, the hemorrhage occurred above the tentorium in 32, below in 10, and in 6 both above and below. He found that only occasionally was the skull fractured.

Internal Hydrocephalus. From experimental observations, our knowledge of the pathology of hydrocephalus has been very largely amplified. The subdivision into three general forms is really of no particular

²⁴ Journal of the American Medical Association, Aug. 3, 1918.

²⁵ Archives Mensuelles d'Obstetrique et de Gynecologie, Paris, April-June, 1918.

²⁶ Svenska Läkaresällskapets Handlingar, Stockholm, March 30, 1918, xliv, No. 1.

moment, inasmuch as all cases coming to the operating table belong essentially to the internal type. The classification should, I believe, be founded on the pathological physiology of the cerebrospinal fluid and that recognizes but three types: one due to the obstruction of the outlet of the lateral ventricles, the obstructive type; the second due to the limitations of absorption, the non-absorptive type; and, possibly, a third due to the excessive secretory activity of the choroid plexus.

Dandy and Blackfan²⁷ review their studies of 26 cases of hydrocephalus, 15 of which were obstructive and 11 of what they call the communicating type. It is well known that there is no obstruction of cerebrospinal fluid within the ventricles, so that the cause of the obstructive type is readily understood. The communicating variety Dandy and Blackfan believe to be the result of adhesions at the base of the brain, which mechanically prevent the cerebrospinal fluid from reaching that part of the sub-arachnoid space where the greatest part of absorption normally takes place. Because of these adhesions, the large basal cisternæ, the normal centers of absorption, are more or less obliterated. By the application clinically of the phthalein test to determine the amount of absorption, these pathological findings may be substantiated. An obstructive hydrocephalus, according to the authors, may be converted into the third or communicating variety; the reverse may also occur spontaneously. There is no doubt that, in the majority of instances, hydrocephalus is due to meningitis; in some instances the meningitis may be plainly marked, in others it may be of so mild a degree as to be overlooked. The frequency of meningitis as an etiological factor has not been appreciated.

As a means of determining pathological dilatations of the ventricles with the *roentgenogram*, Dandy²⁸ proposes the distention of the ventricles with air. In fact, he has injected air into the ventricles twenty times, in quantity from 40 to 300 c.c. In only 1 case was there a reaction, which was characterized by a rise of temperature, nausea, vomiting and headache, and all were relieved after release of the air by ventricular puncture.

With regard to the technic, the ventricle must first be emptied of fluid. It will be seen that the most fluid can be obtained from a puncture in the anterior part of either lateral ventricle. The head should be placed with the face down and partially rotated so that the ventricle to be aspirated is beneath, and the needle enters at the most dependent point possible. This position permits the maximal drainage of fluid from the opposite lateral and the third ventricles. Aspiration through a puncture in the posterior, or descending, horn permits a fairly complete removal of the fluid from one ventricle and from that portion of the other lateral ventricle which is anterior to the foramen of Monro. In the aspiration of fluid from the posterior horn of the lateral ventricle the patient must lie with the face directed upward and backward, and the head rotated from 30 to 40 degrees toward the side of the needle.

The exchange of air for cerebrospinal fluid must be made accurately.

²⁷ American Medical Journal of Diseases of Children, vol. xiv, p. 424.

²⁸ Annals of Surgery, July, 1918, vol. lxviii, No. 1.

If the air injected is greater in volume than the fluid withdrawn, acute pressure-symptoms will result. To attain accuracy, we have used a Record syringe with a two-way valve attachment. A small amount of fluid (20 c.c.) is aspirated, and an equal quantity of air injected. This is repeated until all the fluid has been removed. By aspirating and injecting in small quantities, injury to the brain from negative pressure is prevented. Not knowing the size of the ventricles beforehand, we have no way of estimating the amount of air necessary to fill one ventricle: For this reason we have preferred the removal of all the fluid that can be readily obtained. This has been found to be but little greater than the contents of one ventricle.

Needless to say, owing to the lighter weight of air, the ventriculogram represents the ventricle farthest from the *x*-ray plate. To insure the best results, the sagittal plane of the head should be parallel with the plate. Valuable assistance can also be obtained from anteroposterior *x*-rays. The head should then be placed so that the sagittal plane is vertical, preferably with the occiput resting on the plate. With the latter precaution, a more even distribution of air on the two sides is obtained, and the ventriculogram represents the anterior portions of both lateral ventricles. For special points in diagnosis, additional anteroposterior views may be taken of the posterior and descending horns of the ventricle by placing the forehead on the plate.

All the injections were made on children, varying from six months to twelve years of age. Invariably, the lateral ventricle was sharply outlined in the radiogram, in two instances the third ventricle and foramen of Monro were visible, but in none were the fourth ventricle or aqueduct of Sylvius portrayed. According to the amount of air injected is the time of absorption longer or shorter; in a case of internal hydrocephalus it required two weeks.

As to the practical application of this method of outlining the ventricles, Dandy makes the following statement: (1) "The enlarged ventricles in internal hydrocephalus should be absolutely defined. (2) Tumors in either cerebral hemisphere may dislocate or compress the ventricle, and in this way localize the neoplasm. (3) Tumors growing into the ventricle may show a corresponding defect in the ventricular shadow. (4) A unilateral hydrocephalus may be demonstrable if the air cannot be made to enter the opposite ventricle."

Before passing judgment upon the proposal, I should like to see practical demonstrations of it in just such conditions as the author suggests as suitable for the application, more particularly, of course, tumors of the cerebral hemispheres. I am not so confident of its value as an aid to localization, but I can conceive of its value in a way that Dandy has not mentioned. In so many cases of brain tumors one or both ventricles are dilated, and it is desirable to puncture the ventricle either as a palliative procedure or as in subtentorial growths by tapping the posterior horn at the time of the operation. Now, it would be of very distinct value to know whether one or both ventricles were dilated, and, if so, which one. I have failed occasionally in an attempt at callosal puncture because of the distortion affected by the tumor, either disturb-

ing the normal relations of a ventricle or altogether obliterating the space. Under such circumstances, a roentgenogram of the ventricles would be of distinct value.

Tumor of the Brain. The survival of a patient thirty years after the removal of a brain tumor is a unique record. Keen²⁹ describes in a most interesting way this unusual experience. The operation was performed in 1887, only two years after the first operation for the removal of a brain tumor in 1885 by Godlee. Owing to the historical importance of the case, I quote extensively from Keen's description of the operation:

"Operation. No improvement having taken place, the patient returned to the hospital for operation in the late autumn. The operation was fixed for December 15, 1887. The hospital had formerly been a dwelling house, and was still quite primitive. Before the operation the carpet was taken up, and the walls, ceiling and floor were thoroughly scrubbed with phenol (carbolic acid). New, clean, marine sponges had been kept in phenol, but were used in 1 to 1000 mercuric chloride solution. The instruments were boiled in an open vessel for two hours before the operation; at later dressings they were only soaked in phenol, 1 to 20, for half an hour, and then transferred to boiled water suitably cooled. The phenol spray was used all the morning of the operation, but not during the operation itself or at any of the redressings. The hands were disinfected with soap and water, alcohol and mercuric chloride.

For the operation, a 1½-inch trephine was used. This was considered an enormous size, for the largest I had ever used before was only ½ inch in diameter. Removal of the first button exposed the tumor, but it was much larger than the opening. A second button was removed, and this opening, at that time considered large, was still further enlarged by the rongeur until it measured 3 by 2½ inches. The upper margin was ¾ inch from the midline. The tumor dipped behind the squamous portion of the temporal bone for half an inch. The dura was adherent to the brain except at the margin of this large opening.

I have quoted this rather fully so as to give an idea of the startling size of this growth and to justify the trepidation which I felt in entering on this 'terra incognita,' for this was my first modern brain operation. My heart 'sank down into my boots.' But dangerous as the procedure might be, I *had* to go ahead. I incised the dura one-quarter inch from the margin of the opening in the bone, and with my little finger, to my surprise and relief, enucleated the tumor with as little difficulty as one scoops an egg out of its shell. The hemorrhage was free but not alarming.

It is worthy of note that during the time occupied by controlling the hemorrhage, the large cavity left by the removal of the tumor was half filled up by the resilient brain tissue. The bottom of this deep cavity consisted of softened and in parts shreddy brain tissue. Evidently the roof of the lateral ventricle was intact. The tumor was practically a foreign body starting at the dura as a result of the constant irritation from the little loose fragment of the inner table broken off at the time of the accident and never consolidated with the skull. As the elastic

²⁹ Journal of the American Medical Association, vol. lxx, No. 25, p. 1905.

skull recoiled from the blow, evidently the fragment did not resume its original position, but was in contact with the normal inner table and so could not unite with the bone. Every inspiration and especially every impulse from the throbbing heart produced a slight movement of this fragment. The tumor, a fibroma, slowly but constantly growing, pushed the brain tissue downward.

At the conclusion of the operation, two rubber drainage tubes were inserted and an abundant gauze dressing applied. The bone could not be replaced, as the dura was gone.

The tumor weighed 3 ounces, 49 grains, almost a quarter of a pound. It displaced $2\frac{1}{2}$ ounces of water. Its size was $2\frac{7}{8}$ by $2\frac{1}{2}$ by $1\frac{3}{4}$ inches. Its circumference was $7\frac{1}{4}$ by 6 inches. Its posterior border reached backward nearly to the Rolandic fissure. Pathologically, it proved to be a pure fibroma.

Eight days after the operation the floor of the cavity, which was also the roof of the ventricle, evidently gave way, thus opening the ventricle. From the eighth day until the end of the fifth week, the cerebrospinal fluid continued to escape very freely."

On the eighth day after the operation there were signs of increased intracranial pressure (probably due to a hemorrhage into the tumor cavity), the wound was reopened, a large hernia cerebri developed, with the establishment of a cerebrospinal fistula. The hernia gradually receded, at first to the level, and later to a depression 5.5 cm. below the level of the skull. The patient left the hospital on the eighty-fourth day.

At the autopsy, thirty years and forty-five days after the operation, this interesting condition was found: the cavity originally occupied by the tumor, covered with but a thin fibrous membrane, communicated with the lateral ventricle, the floor of which for a length of 5 cm. was exposed. It is further interesting to note that a cavity of such dimensions should have persisted for so many years.

"*A New Principle in the Treatment of Brain Tumors*" is the title of an article by Strachauer³⁰ which he presented to the section of surgery at the last meeting of the American Medical Association. The title is a little high-sounding, inasmuch as one expects a rather more radical achievement than develops in the course of the article. It seems that the author had a patient upon whom an exploratory operation failed to find a tumor in the suspected region. The intracranial pressure was extreme, but there was no positive evidence of a new growth. Four months later, without the development of any suggestive symptoms, but rather in the hope that something might be found that had not appeared on the surface in the first operation, a second operation was performed and, upon uncovering the brain, a cyst and an attached glioma or sarcoma were uncovered and removed. Upon this experience the author announces his new principle of the treatment of brain tumors. If, at the preliminary exploration, no tumor is found, or if the tumor cannot be localized, a subtemporal decompression is performed, and, subsequent thereto, even in the absence of localizing symptoms, a

³⁰ Journal of the American Medical Association, Sept. 14, 1918.

secondary exploration is made. Rather than looking upon the case as one utterly hopeless and doomed to die, this new principle is advocated.

Intracranial Aërocele. Following a fracture of the frontal bone, there have been only 3 cases of intracranial aërocele described. One of these was discovered by Holmes,³¹ who took two lateral views of a patient, who had been struck on the face and head with a propeller blade. The plate showed a linear fracture through the outer table of the frontal bone and a suggestion of a fracture through the inner table. The frontal sinus was involved, and in the plate taken from the right side there was a large, overcast area, and markedly diminished density in the frontal region. Unfortunately, the significance of these findings was not interpreted at the time the plate was taken, which was within an hour of the accident. The patient was allowed to drift along without an operation for a week, at which time he developed meningeal symptoms, and by a second series of plates a diagnosis of intracranial aërocele was confirmed. An operation was performed, but the patient died two days later of meningitis.

Cerebral Localization. Believing many of the prescribed methods of locating the fissures of Rolando and Sylvius to be unnecessarily complicated, Rinkenberger³² proposes a method which he has found useful and easy of application. It is based on bony landmarks of the skull, which are easy of location, and he has found that most brains occupy the same relative position to these landmarks.

"The method requires four lines run from five landmarks. (1) A line from glabella to lambda. (2) A line perpendicular from the posterior part of the mastoid to the sagittal suture. (3) A line perpendicular from the tubercle of the zygoma to the sagittal suture. (4) An oblique line connecting the junction of the zygoma-glabella-lambda lines with the junction of the mastoid-sagittal suture lines. This oblique line will practically cover the central or fissure of Rolando.

The Sylvian point may be located in two ways: (1) It lies almost beneath (and for practical purposes may be considered to do so) the tip of the greater wing of the sphenoid at its junction with the frontal and parietal bones. (2) A line drawn perpendicularly upward from the middle of the zygoma, until it meets the glabella-lambda line, will cover it at the latter junction. If the glabella-lambda line is followed from this junction to its junction with the mastoid-sagittal suture line, the fissure of Sylvius will be outlined with sufficient exactness for any surgical purpose."

Cysts of the Hypophysis. In a contribution on cysts of the hypophysis, Kanavel and Jackson³³ record a review of 3 operative cases, 2 of which had been previously reported. The first case was operated upon in 1911, and was fed for three years on pituitary extract, at first of the anterior lobe and afterward of the whole gland. There was a distinct, but not normal growth of hair, but no evidence of growth in height or size. The voice did not become masculine, the excessive adiposity was lost, and

³¹ American Journal of Roentgenology, Aug., 1918.

³² Annals of Surgery, Sept., 1918, p. 351.

³³ Surgery, Gynecology and Obstetrics, vol. xxvi, No. 1, p. 61.

the urinary function was restored to normal, except that the sugar tolerance remained above normal at the end of two years. The optic atrophy persisted, but the patient's mentality enabled him to conduct his business in a capable way. The second case, operated upon June, 1913, died the day after the operation of meningitis. The third case, reported for the first time, was a pituitary cyst. The patient was operated upon on three successive occasions, in January, April and September, 1914. At the first operation the cyst was evacuated and the cyst walls curetted; at the second operation the cyst was evacuated, the walls curetted and the cavity packed with bismuth gauze; at the third operation the cavity was packed for three days with a strip of gauze saturated with iodine. Following the removal of the gauze, the patient developed meningitis, from which he finally recovered. Three years have elapsed since the operation, and there has been no recurrence of the symptoms. Excessive adiposity has disappeared, he is mentally alert, but there has been no growth of hair and no return of the sexual function.

In his report on the histological examination of the specimen removed for examination, Jackson writes as follows:

"These tumors all originate from inclusions of epithelium which reach the hypophysis from the craniopharyngeal duct. This duct during embryonic life forms a passage from the pharynx to the brain cavity traversing the sphenoid bone. Its upper extremity pinches off to form the anterior lobe of the hypophysis, while its lower extremity forms the pharyngeal hypophysis. The duct usually atrophies, but in some instances may persist."

The gross characteristics of craniopharyngeal duct tumors render them easy of diagnosis. They originate anterior to the hypophysis in the median line and in their growth push the hypophysis backward and downward, sometimes leading to complete pressure atrophy of that organ. The base of the brain is pushed upward and laterally. As the tumor is bounded by the circle of Willis and early produces pressure upon the optic tracts, disturbances of vision leading to blindness are quite common. The tumors attain a diameter of 10 to 15 cm. and undergo cystic changes early, because of the tendency of buccal epithelium to become hydropic. The cysts contain mucoid or hemorrhagic fluid and their inner surfaces are often covered with papillary outgrowths.

The microscopic picture is that of stratified epithelium of the buccal type lying in an embryonic connective-tissue stroma. Sometimes the epithelium undergoes a malignant change to carcinoma, and regional metastases may be formed. This occurred in four of Erdheim's series.

As to the technic, Kanavel employs the oronasal approach with the submucous resection. The steps of the operation do not differ materially from those in general practice, with the exception of the treatment of the cyst itself. Kanavel advises gentle curettage with a tampon of gauze saturated with a weak iodine solution. This, he says, favors obliteration of the sac and preservation of the opening in the sphenoid.

Discussing in a general way the problem of pituitary cysts, attention is called to the fact that these offer the most favorable prognosis from the surgical point of view. While the patient may recover both physical

and mental properties, in most instances there is no return of certain physical functions, especially those of sex phenomena and of hair growth. If these cysts were recognized and operated upon before puberty, these functions might be preserved or restored, either through normal hypertrophy of the gland remaining or through assumption of its function by the other ductless glands. The fact that many of these cases are not recognized until the time of puberty, or later, may be due to two factors; either the onset of those physiological activities which accompany the cellular hypertrophy at that time of life, or possibly the change in the sight itself incident to the increased secretion. When, at puberty, there is an absence, or marked retraction, of growth, with attacks of transitory blindness, one should at least suspect pituitary disease. Many cases of transitory blindness have unfortunately been looked upon as hysteria, even by ophthalmologists.

In a recent case of my own, total blindness of one eye in a child of five years of age was not recognized until within three weeks of the operation. In fact, the child made his own diagnosis when he told his mother that by placing his hand over the eye in which there still remained some vision, he could play "Blindman's Buff."

Trigeminal Neuralgia. Hutchinson³⁴ continues to advocate the operation which he has practiced a number of years, namely, the partial excision of the ganglion sparing the ophthalmic trunk. In a series of 60 such operations, he has lost but one case, a most commendable record. Of the complications of the operation, he has had 4 cases of hemiparesis, attributed to the pressure of the extractor. This, I think, can be, and should be, avoided, if the opening of the skull is not made too large. By keeping the opening to the skull within reasonable limits, 5 cm. is ample; the upper margin of the bony opening will prevent the harmful effects of pressure from the retractor. I am especially interested in his experience with facial palsy, which followed a few of his operations. Every surgeon with a large experience in this field has observed this complication once in a while, but different explanations have been offered as to the etiology. For example, I found that since I discontinued the use of any form of retraction of the margins of the wound, and this was two or three years ago, I have not seen a case of facial weakness. On the other hand, Hutchinson attributes the palsy to the detachment of the dura mater from the upper surface of the petrous bone, which permits the entrance of blood into the small openings leading to the aqueductus Fallopii. Other explanations have been offered, and the truth of the matter remains unsettled.

As for the principal feature of the Hutchinson operation, there is this much to be said in its favor, as compared, for example, with avulsion of the sensory root in that the possibility of trophic keratitis is reduced to a minimum. The operation would not, of course, be appropriate when the ophthalmic division was involved, and its performance is attended with greater difficulties than that of avulsion of the root. I believe, however, that with the sensory root operation we may prevent

³⁴ *Lancet*, July 6, 1918.

trophic keratitis by leaving the inner fibers of the root intact. In a recent article,³⁵ I reviewed my experience with 302 cases of trigeminal neuralgia, referring chiefly to the treatment by alcoholic injections and by the radical operation. Alcoholic injections are to be recommended in two classes of cases—to those who have long been sufferers and in whom the radical operation may be contra-indicated, and to those in an earlier stage of the disease. In the latter group the treatment by alcoholic injection is almost always acceptable; because of the limited period of suffering the patient is usually not prepared to consider what might be said to be a formidable operation. When I let the patient choose, after presenting the facts to him, he usually chooses the injection. The injection given, he leaves pitifully grateful and encourages himself to believe that this is the end of his suffering, but before the year ends, the pain returns. He fights it out for a while, and then returns submissively for another injection. Three or four years pass with as many injections, and either because the injections are becoming less effective or, and this is the more potent influence, because his courage is failing, the patient despairing of permanent relief, wants the radical operation. This is a very fair analysis of the psychology of the subjects of this disease. While the alcoholic injection is not of itself a serious procedure, it should not be entrusted to the untrained physician. To ensure relief, to avoid such accidents as stiffness of the jaws, facial paralysis, oculomotor palsy, and other complications, the injection should be given by one whose hand and sense of touch have been trained by experience. With regard to the radical operation, it consists essentially in that which I have practiced since 1901, namely, the avulsion of the sensory root, a method of procedure which has since come to be recognized as the logical substitute for the more difficult and more dangerous extraction of the ganglion. Without dwelling upon the steps of the operation, which are fully illustrated in the text, I refer to the results and to the risks.

In considering the *results*, I refer only to the major operation, and review it from the various angles, first as to the permanency of relief, of which there can be no doubt, if the entire root is sectioned. The root cannot regenerate itself. My first operation was performed in 1901, and, when last heard of fifteen years after the operation, the patient was free from pain. In all my 121 intracranial operations, I have been called on only once to operate a second time. In this case, I found that the inner portion of the root had escaped me. This experience prompts me to warn the operator of the ease with which the inner portion of the root may remain attached to the dura and be overlooked. The fibers of the sheathless root are easily separated one from another, and its inner portion, if adherent to the dura, may be concealed behind the retractor employed to elevate the temporal lobe.

The second result of the operation relates to subjective disturbances. The majority of patients, grateful for the relief afforded, accept the anesthesia and numbness without complaint, and soon become accus-

³⁵ Journal of the American Medical Association, May, 1918.

tomed to it. To the minority, the numbness continues to be a source of annoyance for some time.

The motor disturbance, following inclusion of the motor with the sensory root, involves loss of function in the temporal, masseter and buccinator muscles. In a great many instances I have been fortunate in not being compelled to sacrifice the motor root, and, in later years, I find an increasing percentage of cases in which the motor root has been saved. There is more or less inconvenience when the function of the buccinator is lost, since food accumulates in the sulcus between the cheek and the teeth because of the anesthesia and the loss of power in the cheek.

These sensory and motor sequelæ are of no very great moment, at least when compared with the intense suffering, for the relief of which the operation is performed. The only sequel that might be said to be of serious moment is keratitis. This lesion of trophic origin will occur once in a while. If promptly recognized and properly treated, the corneal ulcer will heal. If utterly neglected, as it was in two of my earlier patients, the eye may have to be sacrificed. In addition to these sequelæ, there were four instances in which it was necessary, for periods of several months to several years, to suture the lids at the midpoints. In this type of case, the patient, even with lids sutured, can see to one side or the other, though not directly in front.

In regard to the risks of the major operation, there is naturally a good deal of apprehension on the part of the patient, but usually much more on the part of the family physician. The operation, of course, has its attendant risks, which we might suppose to be proportionately greater than in other major operations on patients past middle life. The supposition, however, has no foundation in fact. There seems to be an extraordinary misconception on the part of the profession as to the present status of the operation on the ganglion or root. It is usually represented as a court of last resort, a sort of kill-or-cure method, as a result of which the patient, if he survives, will be paralyzed on one side of the face and will lose his eyesight. Because of the frame of mind in which the patient consults the surgeon, the former needs some reassuring. In stating the risks of the operation, I refer only to my own clinic. Since 1901, there have been, all told, 4 deaths in 160 operations. Two of these were due to apoplexy, and all of them were among subjects of the 121 intracranial operations. There was one death in 1904, and one in 1910, and there were two in 1912. In a series of 87 consecutive operations, there have been no deaths since 1912.

Over other radical operations, such as the removal of the ganglion, the Abbe operation or the Hutchinson operation, avulsion of the sensory root has so many advantages that it should be, and is, recognized as the operation of choice. It is easier of execution than any other, it subjects adjacent structure to no risk, and is attended with a smaller percentage of corneal complications and with a lower mortality. On the whole, it is the most satisfactory surgical procedure with which I have had to deal.

ALCOHOLIC INJECTION OF THE GASSERIAN GANGLION. I have reviewed this subject at various times, especially with relation to the relative merits of ganglionic injections and the radical operation. Martin³⁶ passes judgment on these two methods of treatment in the following words: "Injection of the ganglion of Gasser . . . will eventually supersede surgical extirpation of the ganglion, division of the sensory root, peripheral and nerve trunk injections, and *other more or less satisfactory procedures.*" (Italics author's.) Patrick, of Chicago, has probably had a larger experience with alcoholic injections than anyone else in this country, and I have always looked upon him as the arbiter in this field. In discussing Martin's paper, he says, like all other methods of deep injection, the Haertel method, which Martin apparently uses, is uncertain, owing to the marked differences in the size and shape of the skull, the foramen may be very difficult to find, and one never knows just where the point of the needle is. Continuing, Patrick says that in his opinion we are not prepared to say that injection of the ganglion or of the sensory root cures trifacial neuralgia. Personally, he believes that it does not, though, of course, it may give relief for a few years or more. Patrick believes that in the relatively young, with subjects in good physical condition, the radical operation should be done by a high-class surgeon with experience in this operation. For those with grave organic disease, or for the very old, one of the injection methods is indicated. With Patrick's views I am in entire accord.

Martin's claim that ganglion injections were permanent in effect, contrary to the views of Patrick, and are to be preferred to the radical, contrary to my views, aroused my curiosity sufficiently to analyze the cases reported in his article. The results are tabulated as follows:

	Sex	Age.	Duration of relief.	Complication.
Case 1	Male	25 years	3 months	Corneal ulcer.
Case 2	Female	.....	4 years	
Case 3	Female	30 years	Recurrence in eight months	Exfoliation of corneal epithelioma.
Case 4	Female	60 years	(a) Recurrence in two and a half years (b) Second injection, only moderate relief	
Case 5	Male	.....	3 years	Neuroparalytic keratitis.
Case 6	Female	.....	3 months	Neuroparalytic keratitis; abducens paralysis.
Case 7	Female	.....	3 months	Exfoliation of corneal epithelioma.

From this table it will be seen that out of 7 cases, 3 had been relieved but three months; 1 had a recurrence in eight months and 1 in two and a half years with only moderate relief after a second injection; the longest periods of relief were three and four years, respectively. Out of 7 cases there were corneal complications in 5, and in 1 abducens palsy.

From this statement it would seem as though a very poor case had been made out for alcoholic injections, either from the standpoint of permanency of relief or corneal complications.

³⁶ Journal of the American Medical Association, Dec. 14, 1918.

I disagree absolutely with Martin's views as to the best method of treating keratitis and base my opinion not on my own judgment, but upon that of de Schweinitz and other experienced ophthalmologists. The eyelids should never be sewed up, says Martin, whereas I am convinced that a stitch or two in the midpoint of the lids offers the most favorable physical condition for corneal repair.

As for the technic, Martin says the technic should be "strictly surgical," whatever is meant by this descriptive term. In my opinion the use of a needle, blindly injected into the tissue, no matter where, is in no sense a strictly surgical procedure. There are several points in his method of injection which attract my attention, first that he uses a general anesthetic. Personally, I use a local anesthetic for the skin and when the needle reaches the ganglion, I give the patient a few whiffs of chloroform or nitrous oxide; either of these will render the patient unconscious of pain. Another point that rather startles one is the statement that it is possible to feel the needle penetrate the dura after it has passed through the tough structure of the ganglion. This must require a degree of delicacy of pressure sense that most operators could not hope to achieve. Still more startling to me is the ability to determine when the needle rests in the sensory root. This is surely a refinement of technic peculiar to Martin's method. Just how one is to determine when the needle rests in the sensory root passes my understanding. Furthermore, assuming the operator was reasonably sure he could place the point of the needle in the sensory root, I fail to see how one could infiltrate the nerve with alcohol, since the root has no sheath, is a structure of very loose texture, and most of the alcohol would escape into the subarachnoid space in the surrounding neighborhood. In giving directions as to the introduction of the needle, Martin says that when the operator thinks the needle rests in the sensory root, the stylet should be withdrawn and, if blood wells up through the needle, the point must be within the lumen of a bloodvessel and an injection should not be attempted until the position of the needle is corrected. I know of no bloodvessel in the neighborhood of the root except the cavernous sinus or the internal carotid artery, and any method which exposes these structures to possible puncture would seem to me prohibitive. Martin wisely recommends the uninitiated to practice, as he does, on the cadaver, but he is more fortunate than his Northern confrères in being able to secure living material for practice among the negroes and at a comparatively cheap rate as vivisection material usually goes. He has done "a lot of injections in negro cases by paying them two dollars for the privilege."

Tumors of the Gasserian Ganglion. My experience with tumors of the Gasserian ganglion includes 3 of 43 recorded cases, or 3 of the 13 cases in which the tumor was exposed on the operating table. The nomenclature "tumors of the Gasserian ganglion," I believe is misleading, since, as a matter of record, with few exceptions, all tumors so designated are tumors of the middle or posterior fossa, with only coincidental involvement of the ganglion and not infrequently of other contiguous nerves. With three exceptions, the "tumors of the Gasserian ganglion,"

so-called, exposed on the operating table, have been inoperable tumors of the middle fossa. Of the 3 cases in my clinic, the tumor, in 2 hitherto recorded, was inoperable; the third case was of interest for two reasons: (1) because the operation was performed within three months of the appearance of symptoms; (2) because the growth was limited in size and well within the bounds of "operability."

The patient, a man, aged fifty-three years, was admitted to my service at the University Hospital, December 22, 1916. He had been suffering for three months from pain in the distribution of the second division of the left trigeminal nerve, which was at first "jumpy" in character, later becoming more intense. This was followed by numbness in the upper lip and was associated with, or followed by, neuralgia above the left eye. The case was regarded as one of trigeminal neuralgia. Two successive alcoholic injections only partially relieved the pain and the patient preferred a radical operation to repeated injections.

At the operation the tumor was found completely encapsulated, about the size of an almond, overlying and appearing to take its origin from the ganglion. There was no difficulty in separating the tumor from the ganglion, except in the neighborhood of the second division. The results of the operation were eminently satisfactory and the patient was discharged from the hospital on the eighth day. When last seen, fifteen months after the operation, there were no signs of recurrence. The tumor, upon examination, proved to be an endothelioma.

The proportion of cases of trigeminal neuralgia to tumors involving the ganglion is in my experience 100 to 1, that is to say, I have seen only 3 cases of tumors in over 300 cases of neuralgia. Symptomatically, tumors of the ganglion are often confused with neuralgia, but in tumors there is often the combination of pain and anesthesia. The pain more frequently involves the entire distribution of the trigeminal nerve, it is of greater intensity and usually without the intervals of freedom so characteristic of trigeminal neuralgia. So, too, it should be remembered in tumors the corneal reflex is often absent, the muscles of mastication are affected, other cranial nerves, particularly the third and sixth, are implicated, and there are the neighborhood symptoms and the signs of increased intracranial tension.

According to Hellsten, the ganglion possesses a peculiar resistance to the invasion of tumors. Practically all take their origin, not from the Gasserian ganglion, but from the dura or some other structure of the middle fossa and involve the ganglion only incidentally. While at first they may be limited to the region of the ganglion, they expand often in the form of a flat growth along the floor of the middle fossa, occasionally invading the orbit, the sella turcica, or even the posterior fossa.

Since the first operation in 1895, there have been recorded, including my own, 14 cases of tumor of the ganglion exposed in operation. Of this number, 10 were large inoperable growths, in only 4, including Percy's³⁷ case, was the tumor operable in the sense that it could be completely removed.

³⁷ Surgical Clinics of Chicago, No. 3, vol. ii.

In Percy's case, the tumor occurred in a male, aged thirty-one years, who had complained continuously and with severe exacerbations for almost two years. Six months before the operation there was numbness in the region of the trigeminal nerve and atrophy of the muscles of the right side of the face and jaw. There was no involvement of any other cranial nerve with the exception of the abducens, revealed in an internal strabismus of varying degree and increasing with the performance of the remaining ocular movements. There was said to be some impairment of hearing on the same side as the tumor, although the significance of this is not clear. There was reported also some photophobia and blepharospasm. The movement of the lower jaw was limited, so that the patient was unable to separate the teeth more than 1.3 cm.

The diagnosis of tumor of the ganglion was made before the operation, chiefly because of the continuous character of the pain and of the involvement of the sixth nerve. The presence of numbness should have been mentioned as an important diagnostic feature. The region of the ganglion was exposed by a large U-shaped osteoplastic flap, somewhat after the manner of the Hartley-Krause incision. The tumor was seen to occupy a position above and attached to the ganglion which was quite pliable and easily grasped with the forceps. The patient's convalescence was uninterrupted and he was discharged from the Hospital three weeks after the operation.

The tumor, which measured 3.5 x 2.5 x 1.0 cm., was closely connected with, and partly included, the ganglion. There was some disagreement as to whether it was a neurofibroma, fibrosarcoma, or endothelioma. In all likelihood the tumor was endotheliomic, as this type has been found in the majority of ganglionic tumors.

Facial Paralysis. As one might expect, the cranial nerves have not escaped injury in the passage of missiles through the neck and at the base of the skull. Thus far, I have seen cases in which the trigeminal, the facial, glossopharyngeal, recurrent laryngeal, spinal accessory and hypoglossal have been involved in one or several combinations. I recall one instance where the bullet lodged at the base of the skull near the jugular foramen. There was anesthesia in the territory of the mandibular division of the trigeminal and a complete hemiatrophy of the tongue. I have seen several instances of injury to the recurrent laryngeal nerve, 1 case of torticollis from involvement of the spinal accessory, one of glossopharyngeal and facial involvement combined. As one might anticipate with the numerous wounds of the face, the facial nerve in its exposed course has been an easy target. In many instances, but one of the two divisions has been damaged; in others, the parent trunk. In addition to these strictly war injuries, there seems to have been an undue proportion of facial paralyses complicating fractures of the base of the skull.

When the damage has been to the trunk near its emergence from the stylomastoid foramen, the methods of dealing with the paralysis do not differ from those which would be appropriate in paralysis of other origin, namely, nerve anastomosis. But where a division or branch alone is involved, I doubt whether it would be possible to find the severed and

retracted ends and unite them. Morestin³⁸ suggests for these cases a muscular anastomosis. In the case he reports, the operation was divided into two stages. At the first, a curved incision was made following the anterior margin of the temporal fossa, extending downward to the malar bone, a distance of 7 cm., and through this incision a bundle of fibers of the temporal muscle was split off with base attached. Beneath the skin of the lower eyelid the fibers of the orbicularis palpebrarum were sought, and to these were sutured with catgut the detached portion of the temporal muscle. Before adjusting the muscular flap, the proper point of attachment was determined by making traction on the flap with forceps until the desired correction was obtained. At the second sitting the buccinator was sutured to the masseter through an incision below the angle of the jaw. The buccinator was then exposed and, with a row of sutures, deflected to the anterior border of the aponeurosis and superficial fibers of the masseter.

This method restored symmetry in repose; it did not accomplish anything like a restoration of function when the face muscles were in action, although even then the asymmetry was less conspicuous. The eye could not be completely closed, but the eyeball was better protected, conjunctival irritation disappeared, as did lacrimation.

A very practicable and worthy recommendation has been made by a surgeon, whose name I cannot now recall, in the adaptation of a principle which has been so forcibly advocated by Robert James in the management of peripheral nerve palsies. The principle involved is the employment of measures to prevent overstretching of muscles and tendons during the interval preceding the period of restored function. This idea is universally accepted as of the utmost importance in the case of peripheral nerves. It should have been thought of long ago in connection with facial nerve palsies. I now employ a strip of flesh-colored plaster, which is applied from the angle of the mouth to the ear so as to prevent overstretching of the muscle. Aside from the physiological usefulness of this, it is of service from the cosmetic point of view in correcting the unsymmetrical appearance of the face.

There was nothing unusual in the report of Halstead³⁹ on an operation for facial paralysis, with the exception of the fact that he recommends chiselling off the tip of the mastoid process and reflecting this with the attached muscle. This no doubt gives easier access to the facial nerve, but has never seemed to me necessary. An anastomosis was effected with the spinal accessory nerve, which Halstead prefers to the hypoglossal.

In discussing the operative treatment of what he calls chronic peripheral facial paralysis, Sharpe⁴⁰ comments upon the fact that in the reported results following operation there has not been a single return of volitional or emotional control of the paralyzed facial muscle, a fact he attributes to the operative methods of anastomosis hitherto practiced. He then proceeds to advocate a "certain method of anastomosis"

³⁸ Bull. et Mém. Soc. Chir. de Paris, 1916, p. 370.

³⁹ Surgical Clinics of Chicago, No. 2, vol. ii.

⁴⁰ Journal of the American Medical Association, May 11, 1918.

which he believes offers a greater ultimate improvement than obtained by other operations. This "certain method of anastomosis" differs from previous methods in that he uses but a portion, instead of the whole, hypoglossal nerve. This claim for superiority in this technic is purely speculative as he has not obtained restoration of volitional or emotional control in any of his cases, at least the results of his operations are not included in his article. Upon what physiological basis he anticipates a larger measure of functional control when using only a portion instead of the whole hypoglossal nerve can be known only to the writer. According to the universally accepted principles of nerve suture, the most certain and the largest measure of functional rehabilitation comes from direct end-to-end suture of whole nerves. Sharpe's implication that his method will attain what might be said to be ideal results is misleading, at least to the general reader. There is absolutely nothing to justify the statement, that in employing one-half of the hypoglossal nerve "is the easier and more rapid regeneration of an end-to-end anastomosis obtained. . . ." The technic of the operation he describes includes no peculiar feature other than the cutting of several of the intact nerve fibers of the remaining half of the hypoglossal nerve and approximating these by a single suture to the peripheral cut portion of the same nerve. What seem to me rather extraordinary statements are made in the paragraph which heads off with "a rather interesting observation." "In six patients, when the impaired facial nerve was divided at the stylo-mastoid foramen, the facial muscles supplied by it twitched from the mere mechanical stimulation to its distal end, and this could be repeated by merely pinching the distal end of the nerve even in those patients in whom a faradic current on the skin failed to elicit a motor response. In 4 of these patients, however, a faradic current applied directly to the distal cut end of the nerve also caused a mild muscular twitch, though not as strong as when the distal cut end was pinched; that is, it would seem, in these patients, at least, that a mechanical stimulus was more powerful than the electrical stimulus. Also, although a reaction of degeneration had been obtained in each of these patients, it is possible that there had been some nerve regeneration distal to the lesion; these findings, therefore, would tend to confirm the original observations of Ballance and Stewart regarding nerve regeneration in the distal portion of the impaired nerve. In only two patients, however, did the motor power return before the faradic excitability appeared. The fact, also, that in these patients, immediately after operation, the flaccid paralysis of the facial muscles was temporarily even more flaccid, and if contractures were present that these contractures were lessened and the flaccidity increased, also tends to confirm the belief that peripheral nerves regenerate not merely by means of a central to peripheral growth, but also by a peripheral repair itself independent of the central outgrowth."

That a response to mechanical stimulation should follow in a nerve when a year had elapsed since the onset of degeneration and the electrical reactions showed reactions of degeneration, presumably complete, seems unbelievable, viewed theoretically, and in my experience on the

operating table, I have never seen such response follow stimulation. The only reasonable explanation must assume that the nerve had not completely degenerated, and the paralysis was partial and not complete. To attribute the twitching of the facial muscles, following stimulation of the peripheral segment, to nerve regeneration in the peripheral segment is harking back to a theory of regeneration that should long ago have been discarded.

The most convincing experimental work, notably that of Huber, proves conclusively that the process of regeneration is essentially central, through the formation of new axis cylinders, which can be traced from above the lesion through the entire peripheral segment, down to, and including, the muscle end plates. The return of function before the return of faradic excitability is not an unusual phenomenon as implied in the text. In another passage, referring to the section of the hypoglossal nerve, it is stated, "it would seem, therefore, theoretically and in this one nerve at least, that the immediate anastomosis of the cut ends of the same nerve, even if a part of the nerve has been removed, occurs very quickly and the entire function is easily regained." The rate of growth of new axis cylinders is pretty definitely established as 1 to 1.5 mm. a day, and there is no reason why one should theorize about or make an exception of the hypoglossal nerve in this respect.

The description of a method of dealing with gunshot wounds of the facial nerve is obscure. The author speaks of effecting an anastomosis of ends separated by one-half inch through the medium of three black sutures. The central end of the facial nerve grows along these sutures and effects a union with the central end. The procedure described, is in reality a "suture à distance" not an anastomosis, and has been discarded as valueless. It is pretty generally accepted that the graft is the only efficient means of dealing with defects.

Elaborating upon the technic, Sharpe says, "Naturally the ends themselves must be pulled back until normal bundles are distinctly seen." To pull back the ends of a nerve as small as the facial nerve after a year of atrophy requires a degree of dexterity and an acuity of vision that most operators do not possess.

SALIVARY GLANDS.

Salivary Fistula. The war has produced an abundance of wounds of the parotid gland or its ducts. Morestin⁴¹ reports 62 salivary fistula, 30 being glandular and 32 involving Steno's duct. Dieulaufé, Pietri and Deupes⁴² also contribute noteworthy papers. A collective abstract based on these four papers is built up by Ivy.⁴³ He represents the following summary:

From the experience of the four authors quoted, the most suitable treatment for the various forms of parotid fistula may be summed up as follows:

⁴¹ Bull. et mém. Soc. de chir. de Paris, 1917, xliii, 835

⁴² Restauration Maxillo-faciale, Paris, 1917, pp. 105, 189, 197.

⁴³ Surgery, Gynecology and Obstetrics, June, 1918, xxvii, 101.

Glandular Fistula. 1. For slight or moderate discharges—immobilization of the jaws, with or without cauterization.

2. For moderate or more obstinate cases—cauterization, or creation of an artificial opening into the mouth by transfixation of the cheek.

3. For persistent cases that do not respond to other treatment—resection of the auriculotemporal nerve.

Fistula of Steno's Duct. 1. For cases in which an appreciable segment of the posterior end of the duct can be freed—transplantation of the duct into the buccal mucous membrane.

2. For cases in which the situation of the fistula and the scar tissue do not permit freeing of a sufficient segment of the posterior end of the duct—creation of an artificial opening into the mouth by transfixion of the cheek.

3. Where internal drainage of the parotid cannot be brought about—permanent occlusion of the duct by ligature.

Pietri, after an experience of 38 cured cases, believes that the simple procedure of immobilization of the jaws should be tried first in all cases before resorting to operation. This favors suppression of the function of the gland and is aided by a liquid diet and by abstention from speech. Jorge and Soler,⁴⁴ claim to have effected cures by a diet of meat, eggs, fat, cream, milk, asparagus and spinach and sodium bicarbonate. They treat the fistula locally with formaldehyde and pressure. Dieulafé does not think immobilization worth while; he recommends cauterization with silver nitrate for small fistulae draining slightly and limited to small groups of acini. Cauterization with a fine thermocautery point has also given him good results. The accessible portions of the parenchyma are reached directly through the fistulous tract by application of the cautery two or three times at three or four days' interval. This may be insufficient and at the same time the lesions may be too insignificant to justify an operation. In these cases Dieulafé makes an incision above and below the fistula (always in the direction of the fibers of the facial nerve) and through this little opening he touches with the cautery all of the exposed surface; he then cures or excises the cutaneous tract and reunites the skin with horsehair or silk threads.

In cases of fistula involving the anterior portions of the parotid parenchyma, and particularly that over the surface of the masseter muscle, Dieulafé practises a modification of the old seton method using rubber as a drain. An oblique tract is made through the gland, the aponeurosis of the cheek, the fatty pad of Bichat, and the mucous membrane, the rubber drain is pulled through and allowed to remain twelve or fifteen days in order to ensure the production of a well-formed false duct. It is important to keep in contact with the bottom of the fistula, to avoid piercing the masseter muscle fibers, and to avoid harming the facial vessels.

Resection of the Auriculotemporal Nerve. I have referred to this previously in discussing the reports of Leriche, in 1916.

⁴⁴ Abstract in Journal of the American Medical Association, 1917, xxvi, 138.

Deupes and Dieulafé commend it, and Ceballos and Bacigalupo⁴⁵ report a successful case. Deupes operates as follows:

1. Local anesthesia with novocain-adrenalin.
2. Vertical incision of about 3 cm. in length, half above and half below the zygomatic arch.
3. Search for the nerve. The pulsation of the temporal artery may be suppressed by the vasoconstrictor action of the local anesthetic solution, and therefore this landmark may not be available. The nerve trunk is behind the vessels, and it may be necessary to seek under the upper part of the incision a peripheral filament, and follow it down to the trunk.
4. Dissection of the nerve in the parotid sheath down to the lower part of the incision, *i. e.*, to the glandular tissue.

5. Gentle traction on the nerve, according to the Thiersch method, with hemostatic forceps in such a way as to obtain the greatest length possible before rupture. This stage is always rather painful.

6. Reunion of the skin edges with Michel clamps.

Dieulafé operates under general anesthesia when there is an inflammatory state of the tissues. He makes an incision in front of the tragus 4 cm. in length, ascending a little in front of the ear and descending as far as the posterior border of the jawbone a little below the neck of the condyle; beneath the skin in front of the ear the temporal artery is carefully sought by its pulsation. Behind the vessels the nerve is found, isolated, seized in a flat beaked forceps, and its peripheral end sectioned; descending the gland the nerve is isolated. In some cases the anastomosing branch from the facial may be seen and cut separately. When the nerve has been isolated from the depths of the gland, a twisting motion is given to the forceps, the nerve being wrapped about the beaks as it stretches, the deepest portions are detached and it breaks solely by the mechanism of avulsion. In operating in a cicatricial field, the search for the nerve is difficult, and it may be necessary to ascend into healthy tissue, find a peripheral branch and trace this down to the main trunk. The operation is useless if all of the glandular portion of the nerve be not resected, taking in all of the secretory fibers and the anastomosing branch from the facial. Dieulafé finds that the secretion of saliva always persists for a few days after the operation, but gradually disappears. He has successfully performed the operation in 5 cases, in 2 of which it was necessary to complete the cure by cauterization, which had previously failed alone.

Ianni⁴⁶ reviews what has been published in Europe on this subject, and gives illustrations showing the physiological basis of the operation. He performed the operation on a soldier with a long war wound of the parotid region that had healed except for a fistula from which saliva poured constantly. The nerve was resected through an incision the same as for ligation of the superficial temporal artery, the nerve being found just below this artery. He isolated the nerve all the way down to the

⁴⁵ Abstract in Journal of the American Medical Association, 1918, 1178.

⁴⁶ *Riforma med.*, Naples, 1918, xxxiv, 731, Abstract in Journal of the American Medical Association, 1918, lxxi, 1947.

parotid gland and then pulled on it and cut the central end. He thus succeeded in isolating a tract 4.5 cm. long, with the small glandular secretory ramifications. The saliva still poured from the fistula for a few days, but by the seventh day the fistula had completely healed, and no saliva issued from the mouth of the duct of Steno. The cure has been complete during the nearly two years to date. None of the persons who have been operated on by this technic experience any inconvenience from the loss of the parotid secretion, the other glands furnishing abundance of saliva.

THE JAW.

Gunshot Fractures. Last year I devoted considerable space to these injuries. A collective abstract will also be found in the International Abstract⁴⁷ for August, 1918, written by Ivy. The April number of *Review of War Surgery and Medicine* also contains a review of jaw injuries. The French literature is very prolific, Morestin alone having contributed 26 articles up to the end of 1917.

A thoughtful and interesting paper has been written by Cole.⁴⁸ Practical experience has taught us that there are three classes of these gunshot fractures: (*a*) where there is no loss of substance and only differences in the details of treatment concerned, (*b*) where there is great loss of substance and any attempt at approximation of the fragments is impossible, and (*c*) where there is moderate loss of substance. In this latter group, one school believes that the maintenance of bony union is of paramount importance and therefore deformity is not only tolerated but deliberately produced. Cole dissents and holds with that school which believes that correct alignment should be determined in every case—the normal arch restored and accurate occlusion maintained. He has thus dealt with 270 cases, with only 30 cases of non-union (11 per cent.).

He believes that non-union may occur even when no substance has been lost and, conversely, union may occur when there has been an extreme degree of comminution. In the first of these one of the causes of non-union must be operative, *viz*: (1) Primary loss of substance; (2) secondary loss of substance due to necrosis; (3) interposition of muscle, fascia, or other connective tissue, and (4) rarely, a central sequestrum. It may be safely assumed that in the ordinary healthy individual bone possesses sufficient regenerative power to make good any defect caused by injury, provided that the conditions are such as to give the best possible effect to factors which favor the process of regeneration. These are considered to be: (1) Prevention of interposition. (2) Restoration or preservation of that stress which is the normal stimulus to the growth of bone. He then shows that even without loss of substance, the interposition of the periosteum or of the masseter at the angle determines non-union.

⁴⁷ Surgery, Gynecology and Obstetrics, 1918, xxvii, 101.

⁴⁸ British Journal of Surgery, 1918, vi, 57.

After discussing the action of the bone graft, and we will not abstract this part—it is too prolific of controversy—he states:

“Thus, then, the bone graft succeeds because it is permeable and absorbable, because it is enabled by continuity of mass to prevent organization of non-bone-forming connective tissues in the gap, and because it restores, by virtue of its solidity, the stimulus of stress to the separated bone-ends. It succeeds, in a word, by establishing exactly those conditions which have been shown to be necessary for union in the case of all fractures with or without displacement, with or without loss of substance.

The attainment of union is undoubtedly important in so far as it fulfils a functional demand. There is, however, no academic virtue in union apart from this, and therefore the ultimate and only test should be a functional one—the patient's ability to masticate ordinary foods. X-ray photographs will not supply such necessary information. Indeed, subjective must take precedence of objective signs, though the latter may determine a strong *prima facie* case. It is precisely this personal factor that renders the measure of functional disability so difficult to estimate. That non-union, used in the strict sense of the term, is not incompatible with perfect function is as certain as that in some cases of obviously sound bony union the ability to masticate hard foodstuffs is denied. In general terms it may be stated that if to the one fragment both the masseters maintain attachment disability is relatively slight.

This functional estimate is obviously of importance from the point of view of treatment. It will be the deciding factor in determining the advisability of endeavoring by open operation to make good the functional defect. The extent of the functional defect and the improvement likely to follow operation should be duly considered. The operative result would appear to be somewhat of an unknown quantity. This is due partly to the distrust of such procedures which many dental surgeons display, and partly to the detached attitude sometimes assumed by surgeons in charge of such cases. The attitude of the surgeon fosters the distrust of the dentist, who tends to adopt ultra-conservative methods, content to suffer present ill rather than adventure worse to follow. Progress in this, as in many other issues associated with war injuries of the jaw and face, has been retarded by lack of proper collaboration between surgeon and dentist.”

In the treatment of the cases of non-union, he states that plating has a small sphere of usefulness. Fractures above the middle of the ramus are probably best left alone; if operation is decided on, a plate may be used to maintain contact if the defect is small. He puts little plates on each fragment and wires the plates. Wiring is useful in cases with little or no loss of substance, particularly at the angle, and practical success may reasonably be regarded as certain.

Most of his cases were operated on by bone grafting. He first performs the necessary plastic operations, closes the fistula and elevates the soft parts. An interval of three months is allowed to elapse, and meanwhile nutrition is promoted by radiation and massage. Two or three days previous to operation upper and lower cast-metal cap splints are

cemented in place with the mouth in the open-bite position. The site of the fracture is exposed and the ends of the fragments cleared, freshened and shaped. The graft is cut from the tibia and small plates are screwed to it before the detaching cross cuts are made. The graft, with detached plates, is then transferred to its destined site and fixed in the gap by screws. He uses the plate because he believes that fixation of the fragments and fixation of the graft are conditions essential to success.

It is obvious that the use of free grafts is open to many serious objections. The employment of bone possessing its own independent blood supply is infinitely preferable. He has practised and describes a novel procedure, namely, the use of a *pedicled graft*, as follows:

"The skin incision is made extending well into the neck, reaching a lower level in front than behind. A flap consisting of skin only is raised to the requisite level. The posterior fragment is thoroughly exposed. The extremity only of the anterior fragment is exposed, so that the extent of the gap may be gauged. An incision is then made through the soft parts clothing the outer aspect of the anterior fragments at a level immediately below the buccal sulcus. The basal margin of this portion of the jaw is then sawed off. The periosteum on the inner aspect of the fragment is incised. Lateral incisions through platysma and deep fascia are made to define the pedicle, which is then gently dissected from the underlying structures.

The graft is thus freed to an extent sufficient to allow easy adaptation in its new position. The posterior fragment is now freshened to provide as broad a surface of contact as possible. Anterior and posterior fragments are now drilled for the passage of a fine silver wire. The wires are passed through the pedicle, surround the graft, and, when tightened and twisted, ensure snug contact between graft and freshened fragments. The soft parts are brought together with a few catgut sutures and the skin is sewed up. A drainage tube is inserted and retained for twenty-four hours. It is scarcely necessary to add that the same type of splint is utilized as for a free graft."

The results obtained by Cole in the operative treatment of non-union may be concisely summarized: Of 30 cases, 2 were abandoned, and 10 have been operated on too recently. Of the 18 others, 13 were considered completely successful, 2 considerably improved, and 3 must be regarded as failures.

Mumby, Forty and Shefford⁴⁹ tabulate a series of 200 cases of injuries to face and jaws; 175, or 87.5 per cent., were returned to duty. There were 95 complete fractures of the mandible, with 15 resulting in non-union (15.8 per cent.). They differ from Cole when they state that "the reestablishment of a normal occlusion and orientation of the dental arch is never sought at the expense of bony union." They use the cast cap-and-bar splint to immobilize the fragments. Platt, Campion and Rodway⁵⁰ differ from Cole in technic. They prefer the rib as a graft and avoid the use of all foreign materials.

⁴⁹ British Journal of Surgery, 1918, vi, 86.

⁵⁰ Lancet, 1918, i, 461.

Ankylosis of the Jaw. Last year I abstracted the excellent paper of Kreusher. Other references to this subject will be found in *PROGRESSIVE MEDICINE*.

This year we have a paper from Mayo Clinic by Henderson and New.⁵¹ They report 3 cases, and divide them into three groups: (1) The articular type in which the joint alone is involved; (2) the extra-articular type in which the fixation is extra-articular, such as scarring in the muscles of the

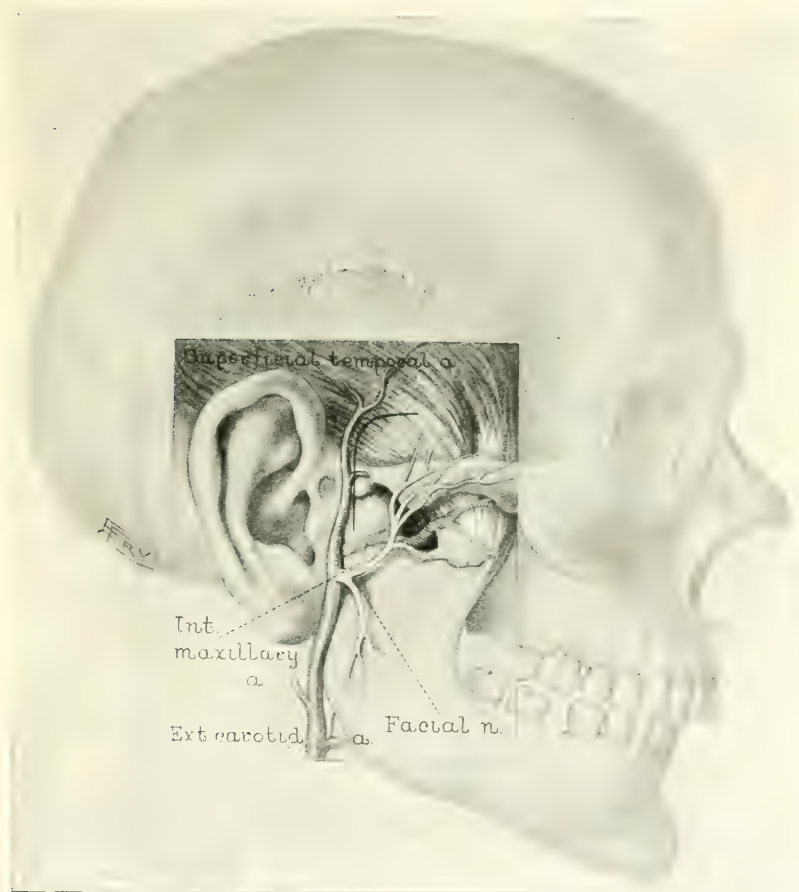


FIG. 1.—Note the superficial temporal artery, internal maxillary artery, facial nerve and the location of the incision. (Henderson and New.)

cheek or temporal region; and (3) the articular-extra-articular type in which the cause of the ankylosis is both within and without the joint. Of the 23 cases, 15 were articular, 5 extra-articular, and 3 articular-extra-articular. Twenty-two resections of the condyle were done, 19 in the articular cases, and 3 in the articular-extra-articular cases.

Contrary to the opinion of Blair, who states that 50 per cent. of the

⁵¹ *Surgery, Gynecology and Obstetrics*, 1918, xxvii, 451.

cases are due to trauma, only 3 of their patients had this factor in their history. Murphy stated that most cases were due to the extension of the middle ear infection; in this series, only 1 case gave such a history.

They offer an operation which approaches the joint from above by removing part of the zygoma, and which does not injure the facial nerve. The technic of the procedure is as follows:

"The incision is curved and about two inches long. Its anterior and upper portion runs one-half inch above and parallel to the zygoma. The posterior arm extends downward just in front of the ear to about the level of the floor of the external auditory canal. This skin flap is partially dissected free in order to expose the zygoma. If necessary, the superficial temporal artery may be divided. An incision parallel

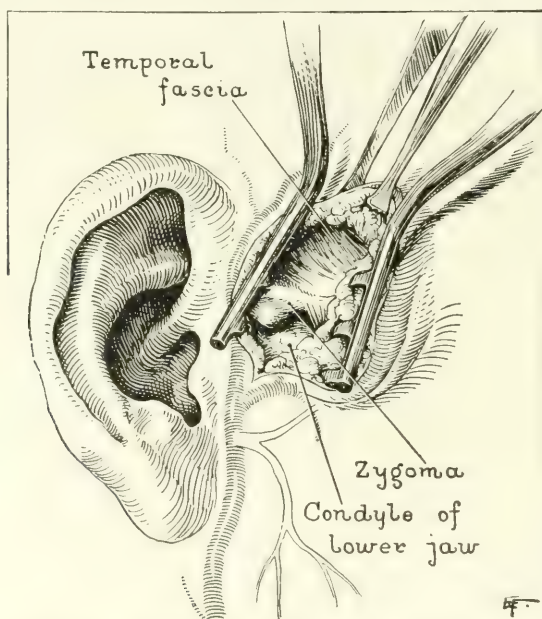


FIG. 2.—Exposure of the zygoma and condyle. The retractor holds the soft tissues and facial nerve downward and forward in the flap. (Henderson and New.)

to the zygoma and directly over it is made and the temporal fascia is retracted downward, exposing the zygoma and the joint region. The entire flap is then turned downward and forward, carrying with it, and holding out of the way of injury, the temporofacial branch of the facial nerve. The safest form of retraction is by the use of a self-retaining mastoid retractor placed obliquely in the wound (Fig. 2). If the retraction is left to an unskilled assistant, he may, in his zeal for exposure, use too much force and a temporary facial paralysis will occur, the result of stretching. The next step consists in the removal of the part of the zygoma directly over the joint area, care being taken not to injure the external auditory canal, and to leave a small bridge of the zygoma to maintain facial contour. This exposes the condyle and it can be removed

with a chisel gouge (Fig. 3). The bone to be taken out should be carefully removed by chiseling off small pieces. If rongeur forceps are used and big bits taken, and the bone is twisted out, the internal maxillary artery may be injured. It not infrequently happens that when there is a bony ankylosis, the ramus and even the coronoid process is involved in the mass. A large quantity of bone must then be removed, and a space at least one-half inch in width must be left between the neck of the ramus and what formerly was the glenoid fossa (Fig. 4). If the coronoid process is involved, a sufficient amount of it must be removed to permit free motion. This can be done by working forward through the same exposure. No fascia, fat, membrane or foreign material of any kind is placed between the end of the mandible and the temporal bone. When the bone is removed and motion secured, the wound is closed.

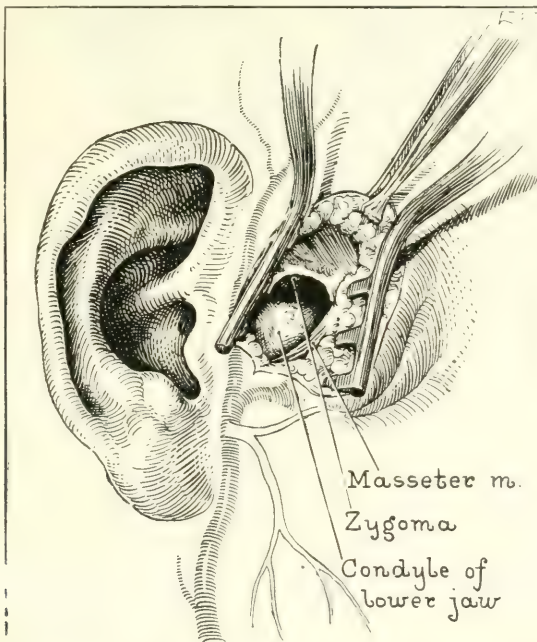


FIG. 3.—The zygoma over the joint is removed, giving a better exposure for the removal of the condyle. Note small bridge of zygoma remaining. (Henderson and New.)

If, after the completion of the arthroplasty, sufficient motion has not been obtained, in a case in which there is no facial deformity, and in which it has not been possible definitely to determine the side chiefly affected, the surgeon is forced to conclude that the other side is at fault, in which case the second side should be operated on later. On the other hand, occasionally after the removal of bone, the amount of motion obtained has been disappointing, though there has been no question but that the side operated on was the affected side. In such a case the trouble is in the muscles and peri-articular structures. Too vigorous

attempts to open the jaw widely with the mouth-gag or the threaded block of wood, are to be condemned for the teeth are often broken needlessly. By patiently forcing the mouth open each day with a mouth spreader, motion will steadily improve. The patient himself uses the spreader. He is encouraged to chew gum and thoroughly to chew meat, preferably tough meat, at his meals.

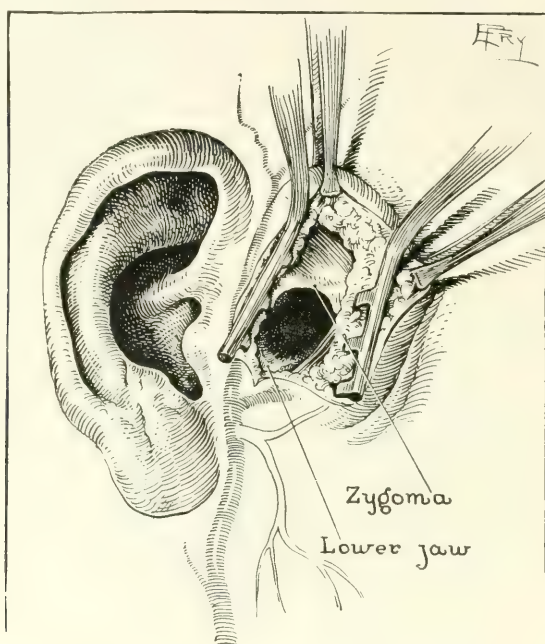


FIG. 4.—The condyle removed, exposing the space between the upper end of the ascending ramus and skull. (Henderson and New.)

Injuries to the Malar Bone and Zygoma. Todd⁵² calls attention to injury the extent of which may easily pass unrecognized by reason of the primary swelling until deformity becomes manifest. His investigation was made on a series of skulls in the Museum of the Anatomical Laboratory of the Western Research University. In a combined total of 467 skulls, 38, or 8.1 per cent., were pathological deformation of the cheek bones. He describes these in detail, and in his summary states that, contrary to the usual impression, fracture or fracture-dislocation of the malar bone occurs alone or with extension only to the maxilla more frequently than as part of a widespread lesion; and that damage to the zygomatic arch is much more common than injury to the malar itself. The failure so far to appreciate these facts is quite natural, for the great majority of cases never come under clinical observation, since they are accompanied by no permanent disability causing the patient marked inconvenience. The most frequent permanent derangement

⁵² *Annals of Surgery*, 1918, lxvii, 443.

appears to be deviation of the axis of the corresponding eyeball. Interference with the action of masticatory muscles is usually temporary, and affection of the infra-orbital nerve results in no pronounced symptoms.

Involvement of the temporomandibular joint, permanent blindness, and other grave complications result from a much more severe injury. Cases exhibiting such serious disabilities form by far the greater number of those presenting themselves for treatment. Instances of less severe damage do not usually appear upon clinical records.

Recurrent Dislocation of the Lower Jaw. This rare luxation is usually treated by removal of the interarticular fibrocartilage, or suture of this cartilage to the periosteum of the condyle; suture or reefing of the capsule is also recommended. Because of the depth of the articulation making operation very difficult, and because a plastic on the joint itself has to work against powerful leverage favoring recurrence, Blake⁵³ proposes to disregard the joint and to lace or bridle the coronoid process to the zygomatic arch. He reports a case and details the operation: "An incision was made along the lower border of the zygomatic arch and the fibers of the masseter separated from it. This incision was well above Stenson's duct and parallel to the facial nerve fibers. With some difficulty, the coronoid process was reached; it was much deeper than had been anticipated, and I was not able to do what I had originally planned; this was to drill through the tip of the coronoid, thread a piece of silver wire through the hole and lace this over the zygoma. I therefore looped the wire first over the zygoma and then brought it down and carried it through the insertion of the temporal muscle and the periosteum on the front of the coronoid, twisted the ends together, flattened it, and closed the wound without drainage. The wire loop was long enough to allow the jaw to open for 2 cm., or one inch between the incisors. The masseter was carefully sutured to its origin; bandages held the jaw closed, and the wound healed by first intention. The jaw was immobilized three weeks, probably longer than necessary. For some time the patient either could not or would not open the teeth more than 1 cm., saying either that it hurt or that he was still afraid it would slip. Gradually, confidence and a wider range of motion returned. Now more than a year after the operation, his jaw is normal and reliable in every way, the excursion being about 4 cm. at the incisors. The x-ray shows that the wire has twisted from its original position, but it does not cause any discomfort, and gives a mental sense of security to its somewhat excitable and erratic possessor."

Blake proposes that kangaroo tendon or chromic gut might be preferable to wire, and that it is not worth while trying to drill the bone; instead, one should go directly through the structures on the front of the coronoid process. The parts should not be immobilized for more than two weeks. Careful suture of the masseter is essential, both from the point of strength and of cosmetics.

⁵³ *Annals of Surgery*, 1918, lxxviii, 141.

Radium in Superior Maxilla Tumor. Janeway⁵⁴ reports upon 55 patients with tumors of the superior maxilla treated by radium, assisted when necessary by a conservative operation. These tumors have included 8 benign tumors and 47 malignant growths, of which 4 were sarcomas and 43 epitheliomas.

Of the benign tumors, the papillomas are the simplest. One variety is a simple circumscribed tumor resembling a common wart. They are most frequently on the tongue and lip and may undergo malignant transformation. The other variety is sessile and spreads superficially over large surfaces. All of the papillary growths are easily cured by surface applications of radium.

The malignant epithelioma tumors constituted the greatest and most important number. In 21 cases the tumors began to grow in the mouth on the superior alveolus; in 18 patients the growth originated either within or in close relation to the nasal cavity.

SYMPTOMS OF ONSET AND DURATION OF THE DISEASE BEFORE APPLICATION FOR TREATMENT. The symptoms of onset are of much importance, as so much can be accomplished with these cases when treated early.

The oral cases are the easiest to diagnose in the early stage, and in the majority of these the first symptom is ulceration. A few complained of loosening of the teeth in the superior alveolus. The subsequent symptoms are increase in size of the ulcer, swelling of the superior alveolus and later of the face. An intelligent patient will usually seek medical advice when the lesion is small.

In the antral cases the first symptom may be any one of the following named in order of their frequency:

Irritation of the eye, due probably to obstruction of the lacrimal duct, swelling of the face or alveolus, nasal obstruction, or pain or loosening of the upper teeth.

Among the nasal cases, nasal obstruction and discharge and irritation of the conjunctiva were the initial symptoms. Any recurrent or persistent conjunctival irritation, not affecting the whole conjunctiva uniformly but more intensely the conjunctiva in the neighborhood of the lachrymal duct, particularly if coupled with some nasal obstruction, coming on without the ordinary symptoms of a cold in the head, should excite the suspicion of being caused by a tumor within the antrum. Transillumination and a radiograph then become valuable diagnostic aids.

Sooner or later, there is marked swelling of the face and alveolus with evident distention of the antrum, more complete nasal obstruction, or, if the orbit becomes invaded, which it frequently does in the nasal cases, exophthalmos develops. Pain now becomes added to the other symptoms, nutrition becomes interfered with, and the patients progressively lose in weight and strength, until death occurs.

The regional lymphatics become involved rather late in the course of the disease. The following table gives the average duration of the

⁵⁴ *Annals of Surgery*, 1918, lxviii, 353.

disease from the time when symptoms were first noticed until (in the first column) the patients applied for treatment and (in the second column) until they were referred to us. In the third column is the average total duration of the disease in the case of those patients who died, and in the fourth column the percentage of patients who developed enlarged regional lymphatics; at least as long as they were followed by us, which represents the whole of the disease in many and most of it in others.

		Average duration of the disease before applying for treatment.	Average duration of the disease before being referred to us.
Oral cases		7.10 months	13.70 months
Antral cases		4.00 months	14.30 months
Nasal cases		5.75 months	5.75 months

	Average length of the disease in those patients who have died.	Percentage of cases developing enlarged cervical lymphatics.
Oral cases	13.8 months	Average of 4 cases only, the others still living
Antral cases	12.4 months	Average of 5 cases only
Nasal cases	5 months	Average of 2 cases only

	Lymphatic involvement.	
	with.	without.
Oral cases	7	14
Antral cases	6	12
Nasal cases	1	3

Treatment of these Cases. As in all cancers, Janeway found that the results bore a direct relation to the stage of the disease. He states that those treated in the early stage while the disease was still localized have given excellent results with radium alone. In those patients in whom the disease was still further advanced, but still circumscribed, good results have been obtained by the use of radium. Janeway offers some unusual advice in the management of these cases. He condemns major surgery on the local lesion, but no mention is made of the necessity for dissecting out the neck to remove the lymphatic extension. He concludes that a comparison, with operative results, supports the belief that the use of radium materially increases the therapeutic possibilities of cancer of the upper jaw with far less risk. The following are his remarks *in toto*:

"In the treatment of carcinoma of the antrum, as is the case with the surgical treatment of cancer, our results bear a direct relation to the stage of the disease in which the patients come to us.

Those patients who were treated in an early stage, while the disease was still small and localized to its primary seat, have given to date excellent results with radium alone. In those patients in whom the disease was still further advanced, but yet well circumscribed, good results have been obtained by the use of radium combined with a conservative operation which rendered the whole region involved more accessible to the radium. In the more advanced cases the same plan has given good temporary results, but none of these patients have been cured.

In an early growth still well circumscribed upon the alveolar border, even if it involves the adjacent portion of the cheek, a radium applicator

can be made of dental modelling compound, which may be filled with filtered emanation tubes. We sink the tubes, whenever possible, to a depth of 5 mm., and distribute them as uniformly over the surface as possible, generally using enough tubes to make one tube for every 1 sq. cm., or $1\frac{1}{4}$ sq. cm.

Such an applicator may be held in the mouth of the patient for any reasonable length of time, one to four hours if necessary, and will cover the lesion accurately. For superficial lesions we use $\frac{1}{2}$ mm. of silver as a filter. In deeper cases we use 1 mm. of platinum.

Whenever there is the slightest suspicion that the growth may have penetrated into the antrum—and it must not be forgotten that it often begins in the follicles of teeth which open into the antrum—or when we are dealing with a growth which is primary within the antrum, some operation must be performed which thoroughly exposes this cavity. I do not believe that anything is gained in those tumors primary in the antrum, or in the more advanced alveolar cases, which have invaded the antrum secondarily, by the disfiguring operation of resection of the whole of the superior maxilla through the usual incision of the Ferguson-Webber operation below the eye and along the side of the nose and through the lip; or by making a direct opening through the anterior wall of the antrum from the surface of the face. These operations seldom succeed in removing all the disease; so that, if an ultimate cure is to be expected, some other agent, as radium, must be depended upon. An operation which provides good drainage to the antrum and enables the operator to expose the whole of the disease intimately to the radium is alone necessary. The removal of the superior alveolar process and sufficient of the adjacent portion of the hard palate as may be necessary in case the nasal cavity has been invaded, accomplishes this purpose. This procedure can easily be accomplished, together with a preliminary ligation of both external carotids, under local anesthesia. The neck work is done under infiltration anesthesia and mouth work by induction anesthesia, the emerging branches of second and third divisions of the fifth cranial nerve being easily reached by a long needle appropriately introduced below the malar bone. This operation gives excellent drainage and perfect exposure and, whenever it is unnecessary to invade the nose, very little inconvenience to the patient afterward, as the opening fills in and contracts down in a most satisfactory manner. When it is necessary to remove enough of the hard palate to open the nasal cavity, a plate may be worn later.

The nasal cases must be managed differently. In all four patients of this series, the cavity of the orbit had been invaded. In order to obtain proper access in these cases, it is necessary to remove the eye, the orbital plate of the ethmoid and the floor of the orbit. This procedure gives complete exposure to the antrum, the orbital cavity and the nasal cavity.

Any temporary opening of these cavities by an incision beginning above the eye and along the side of the nose will surely be followed by disappointing results."

Surgical Treatment in Malignant Tumors of the Jaws. Ochsner⁵⁵ has treated 100 cases since 1906, of which 67 per cent. were cancer, 16 per cent. sarcoma and 16 per cent. were epulis. Forty-seven cases originated from the lower jaw, 25 from the upper and 6 from the antrum in the cancer and epulis group. Of the sarcoma, 8 originated in the upper jaw and 4 in the lower jaw. Ochsner had a mortality of 20 per cent. in his hospital. He anesthetized his patient with ether and operated in a semi-sitting position. In cancer cases he prefers the cauterizing iron to remove the malignant growth and cauterizes deeply and widely, but prefers excision of the jaw in sarcoma.

Another advocate of the use of heat, and also of radium in the treatment of cancer of the jaw and cheek, is New,⁵⁶ who reports a series of 57 cases from the Mayo Clinic. From these, 21 were selected without glandular involvement, and retreated in the following manner:

"After the patient is anesthetized with ether a mouth-gag is inserted opposite the affected side. The tongue is drawn to one side out of the way, by the aid of a stomach clicker. The water-cooled speculum is inserted, and all the teeth in the area involved, or those that prevent good exposure of the growth are removed. If it is possible, the entire growth is excised from the jaw or cheek with a knife cautery, and the base is cauterized with soldering irons. If this is not possible, the irons are inserted into the tumor. The water-cooled speculum prevents the burning of the lips or cheeks except in the area being treated, and it affords good exposure. A wooden tongue depressor holds the tongue out of the way and prevents it from being burned. The cautery should be used longer than seems really necessary—at least for from twenty to forty-five minutes. If the growth is in the upper jaw and involves the antrum, the soldering irons are carried up into the antrum and the entire growth is gradually burned away.

Soldering irons are found to be the most satisfactory type of cautery, as the heating element in the handle of the electric cautery usually interferes with a good view of the area that is being treated. If the irons are too hot, the surface cauterized becomes carbonized and prevents the penetration of the heat. A slow heat that gradually cooks the tumor is preferable.

Occasionally hemorrhage will occur during the first ten days or two weeks following the cauterization while the slough is clearing off, and, if it is not readily controlled by packing, ligation of the external carotid with the lingual and facial branches is advisable.

About two weeks after the cauterization, most of the slough will have cleared off, and radium may be applied directly into this open area. It is directed into the ulcerating area on lead applicators, using a 50 or 100 mg. tube within a silver tube, for from fifteen to twenty hours, without screening. If the growth has involved the cheek, radium is applied with screening externally over the cheek, thus cross-firing. If the growth has involved the antrum, the radium is placed in the antrum,

⁵⁵ *Annals of Surgery*, 1918, lxxviii, 136.

⁵⁶ *Journal of the American Medical Association*, 1918, i, 1369.

packed there with petrolatum gauze, and left in place for the period of hours required by the particular type of lesion.

In from a month to six weeks after the operation, large pieces of sequestrum usually come away from the jaw. These pieces are sometimes one-fourteenth to three-eighths inch thick. In a month from the time the first radium treatment is completed, further treatment is given and repeated as often as the condition indicates. If there is any recurrence noted a second cauterization is done, and this is followed by radium.

Epithelioma of the jaw does not, as a rule, metastasize early, unless there is considerable involvement of the cheek. In such a case, the submental and submaxillary glands on the affected side should be removed."

Of the 21 patients so treated, 20 were traced, and, of these, 14 were found to be free of local occurrence for from six to eight months; two of them, however, have developed glands of the neck, and have had block sections. There was no operative mortality.

It has been my custom for some time to treat cancers of the oral cavity by means of the cautery instead of using the knife. Recently, however, I have been better pleased with the results obtained from the distribution of the local lesion by electrocoagulation. The destruction seems just as complete and the resulting scar smoother and accompanied by less contraction. Clarke⁵⁷ reports an analysis of 200 cases treated by electrothermic methods. Contrary to the opinion of Janeway, expressed above, he states that he has never seen any benefit result from the use of the x-ray or radium alone in the treatment of cancer within the oral cavity. Clarke further remarks that:

"Before large growths at the base of the tongue, epiglottis, larynx or esophagus are treated, a tracheotomy should be done first and the larynx packed from below to prevent aspiration of toxic or other secretions. The ligation of the external carotid, and in rare instances the common carotid, may be practised as preliminary to the treatment of some growths of the throat. Hemiplegia may occur, however, in the latter instance."

Deep, cross-fire roentgen therapy, according to standard technic, should be applied to the neck after dissection of the cervical glands, with the hope of preventing recurrence. When the glands are not involved, the roentgen ray should also be applied to them after electrothermic treatment of the primary lesion. The roentgen ray is of more value in the latter instance than in the former, as its use often prevents involvement of the glands, and when they are involved the roentgen ray will often retard the progress of the disease. Deep, cross-fire roentgen therapy may be used following electrothermic destruction at the site of the primary lesion to reach possible outlying cancer cells, as may radium, especially within the mouth; but the same area should never be treated by both the roentgen ray and radium. He has never seen any benefit result, however, from the use of the roentgen ray or radium alone in the treatment of cancer within the oral cavity, but the

⁵⁷ Journal of the American Medical Association, 1918, lxxi, 1365.

roentgen rays are of undoubted value as an adjunct to electrothermic methods and surgery."

Pfahler is also an advocate of electrocoagulation as an adjunct to roentgenotherapy. It is his custom, "in nearly all instances, to destroy superficial malignant disease by electrocoagulation before applying the roentgen rays. This applies to all the epitheliomata of the skin, both the basal cell and squamous cell; all the epitheliomata of the lip and the mucous membrane of the mouth; epitheliomata of the vulva and of the penis." He is sure that he gets more patients well, and better and quicker results in this group of patients, than by any other means or any other combination. After the disease is destroyed and the dead tissue curetted away, the area is treated by deep roentgenotherapy, and in mouth cases or mucous membrane cases the glandular areas in the neighborhood are thoroughly treated. This roentgen-ray treatment is repeated again in four weeks, and after that as many times as seems necessary, according to the degree of malignancy, the location and the extent of the disease.

He advocates surgery in deep-seated tumors, such as in cancer of the breast, and believes that metastatic glands should be removed surgically, because while he has seen enlarged glands disappear under x-ray treatment, he has been particularly disappointed in the group of cases in which the enlargement has been secondary to cancer of the mouth.

Radium in Cancer of the Lip. Janeway⁵⁸ reports on the treatment of 24 cases at the Memorial Hospital, New York. Of these, 8 were superficial early lesions and 16 were well-established cancer, with deep invasion of the tissues of the lip. With the exception of 3 cases now under treatment, and at present doing well, but who had advanced lesions when they applied for treatment, the patients have all been well and are free from evidence of disease. The technic employed by Janeway was as follows: He applies radium emanations embedded in molds of the dental compound and filtered through the thinnest material for the most superficial lesions. As a matter of convenience we have used 0.5 mm. of silver uniformly for all but the lesions with deep infiltration. While 0.5 mm. of silver has been unnecessarily heavy for the most superficial lesions, it has given uniformly satisfactory results in our cases. For the deeper lesions, however, nothing has surpassed the progressive, smooth and complete retrogression produced by filtration through 1 mm. of platinum. The tubes should be sunk 5 mm. in the dental compound, and for the ordinary lesion the dose should be 60 mc. hours per square centimeter, when the filtration is through 0.5 mm. of silver, and 100 mc. hours per square centimeter when through 1 mm. of platinum.

RETROPHARYNGEAL ABSCESS.

We have reviewed the literature bearing on this important and practical subject in previous numbers of *PROGRESSIVE MEDICINE*. Two

⁵⁸ Journal of the American Medical Association, 1918, lxx, 1051.

more papers may be added. Rush⁵⁹ reviews the anatomy and its applications to the etiology:

"The development and course of retropharyngeal abscess are better understood if one keeps in view the different layers of tissue that intervene between the pharynx and the cervical vertebræ.

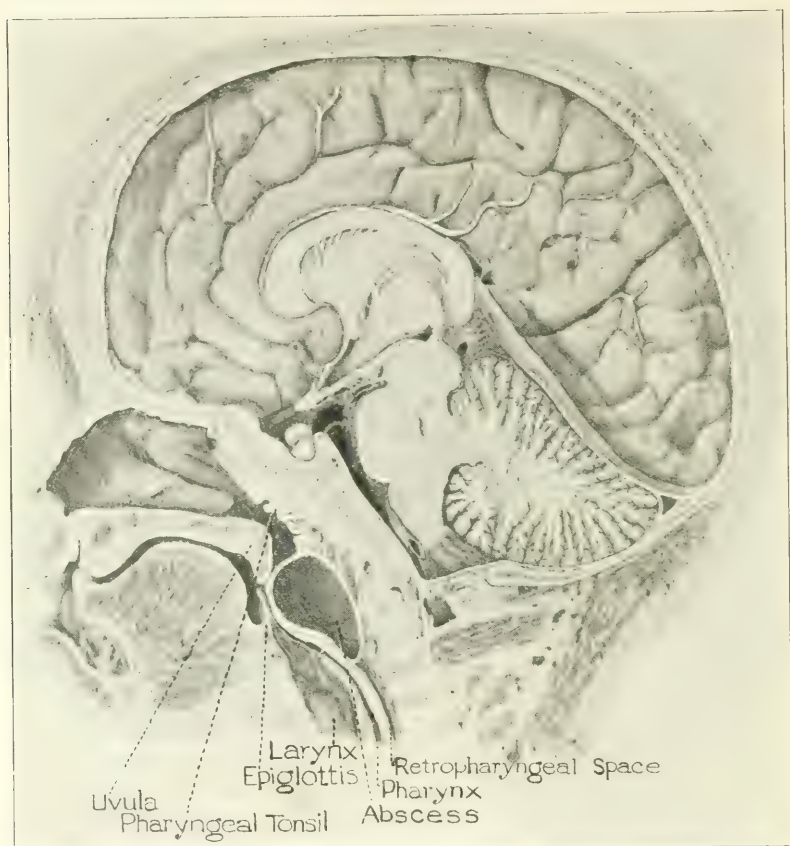


FIG. 5. -Retropharyngeal abscess. (Rush.)

Dorsal to the mucous membrane of the pharynx is the pharyngeal aponeurosis, a loosely attached fascia permitting of free movement and free swelling. This fascia is followed by the constrictor muscles, which are in turn covered by the thin buccopharyngeal fascia. This fascia is but loosely attached by areolar tissue to the strong prevertebral fascia which follows. The loose areolar tissue space—the retropharyngeal space—permits of free expansion. The strong prevertebral fascia covers the prevertebral muscles which overlie the cervical vertebræ. It is evident, when pus forms dorsal to the prevertebral fascia and is confined there, that extension must be limited, whereas, if present ventral

⁵⁹ Journal of the American Medical Association, 1918, lxxi, 174.

to the fascia, in the loose retropharyngeal fascial space, the freest extension is possible.

The source of infection leading to abscesses posterior to the pharynx are usually classified under four headings:

1. Those due to caries of the upper cervical vertebræ, usually of tuberculous origin. Such an abscess, being dorsal to the prevertebral fascia, is very apt to burrow laterally and appear as a tumor in the neck, dorsal to the sternocleidomastoid muscle, where it should be opened under the strictest asepsis to prevent a mixed infection. If unopened, it may follow the brachial plexus into the axilla. Regardless of the prevertebral fascia, it may, however, burrow forward in the midline of the pharynx.

2. Those due to an otitis media. The pus probably burrows downward in the upper part of the Eustachian tube along the tensor tympani muscle to terminate behind the prevertebral fascia. It tends to point in the same direction as infection from cervical vertebral caries.

3. Those due to an extension inward of a carotid abscess.

4. Those due to infection of the lymph nodes of the retropharyngeal space. These nodes are one or two in number on either side of the midline opposite the lateral masses of the atlas. They receive lymphatics from the nasopharynx, Eustachian tubes, nasal fossæ and accessory sinuses.

The abscess accordingly lies in front of the prevertebral fascia and usually, as in the case reported, points into the pharynx. If not opened by the surgeon, it causes dyspnea, dysphagia and dysphonia and probably death from suffocation, or the abscess may rupture and the pus be swallowed or drawn into the larynx. In the latter case death from suffocation or septic pneumonia may result. As the retropharyngeal space is composed of loose connective tissue extending downward behind the esophagus to the posterior mediastinum, failure of evacuation permits the abscess to follow a course of slight resistance downward into the thorax."

To this we may add the remarks of Schiller⁶⁰ on the symptomatology of the disease in infants. He states that in these the disease is a suppurative lymphadenitis (Source 4 of Rush) and that in children and adults it is a spreading or burrowing of pus from some other source, such as a tuberculous spine, peritonsillar abscess or submaxillary abscess. One per cent. of scarlet fever and 0.5 per cent. of measles are followed by retropharyngeal infection according to Schiller.

Symptoms. "Occasionally there are no symptoms; spontaneous rupture, asphyxia and death occurring without warning. The first symptom observed by the parents is usually difficulty in swallowing or breathing. In only 3 out of 27 cases which I saw was the submaxillary adenitis the symptom that attracted the mother's attention.

The first sign, and the one that every case presents, is the submaxillary adenitis. Even before there is any swelling in the pharynx large enough to induce any other symptom the adenitis already exists. The adenitis is unilateral, being on the same side as the retropharyngeal abscess.

⁶⁰ Medical Record, 1918, xc, 457.

This adenitis is so typical and so characteristic that I make my diagnosis on the adenitis and then verify it by examining the pharynx. On examination, there is a puffiness, but the skin is never red. On palpation the swelling is soft, never hard; the glands are small and distinct, never matted together. The amount of swelling is out of proportion to the size of the glands, the latter being small, but the puffiness marked. There is a marked infiltration of serum in the periglandular tissue, this, and not the enlargement of the glands, causing the swelling in the submaxillary area.

The other symptoms that are usually present depend upon the location of the abscess. If it is situated in the nasopharynx the cry is nasal, the child snores, and has difficulty in breathing. When located in the oropharynx, it may cause difficulty in swallowing. This may be due either to the pain of the inflammatory condition or the mechanical obstruction by the mass. If the abscess is lower, about the epiglottis, the symptoms are hoarseness, stertorous breathing and attacks of choking and cyanosis.

On examining the pharynx, the abscess can be seen only if it is located in the oropharynx; hence the absolute necessity of making a digital examination in every case, for often the abscess cannot be seen but only felt.

Treatment. The treatment is surgical. The abscess cavity should be opened as soon as fluctuation is detected. The incision, whether made by a scalpel, the tip of which only is exposed, or by the finger, which is the method I use, must open all pockets of pus.

The patient is seated in the lap of the assistant, the body of the infant is held firm. The mouth is then opened and kept open either by a tongue depressor held between the jaws or by the cheek of the patient pressed inward between the jaws. As soon as the abscess is opened, the head of the child is bent forward to permit the pus to drain through the mouth and nares. By this method the pus and blood are prevented from entering the trachea and causing asphyxia. A mouth-gag should never be used to keep the jaws apart. Snow has reported a death following the use of this instrument."

GOITRE.

There is hardly anything to report in the way of progress this year. We have been so accustomed to the authority of those practising in so-called goitre belts that the experience of Jones⁶¹ from the Southeast United States is well worth repeating. He finds that goitre in that area is relatively rare and that the incidence of the several types does not differ materially from the incidence in other areas. He has studied 407 cases, of which 140 were toxic. He prefers a maximum double resection in diffuse enlargements.

Exophthalmic Goitre. Sloan⁶² gives us the results at the Lakeside Clinic for 1915, 1916 and 1917 to October 1. There were 398 operations,

⁶¹ Journal of the American Medical Association, 1918, lxxi, 712.

⁶² Illinois Medical Journal, 1918, xxxiii, 152.

with 15 deaths, a mortality of 3.8 per cent. In my series the mortality in toxic goitre has been 3.5 per cent.; in 1415 cases assembled from Ochsner, Judd, Porter, David and Dowd it was practically the same. This year, Terry⁶³ reports 420 cases, with a mortality of 3.2 per cent.

In discussing *treatment*, Sloan states that "the mildest measure that we employ in our attempt to curtail thyroid activity is the injection of quinea-urea. Next, by means of ligation of the superior poles; further, by means of injection of hot water into the gland and finally thyroidectomy. Very sick patients receive injections into the gland of a 50 per cent. quinine-urea solution. We graduate the amount from 5 to 10 c.c., the smaller dosage being used in the upper poles and the larger amount in the mass of the gland. Previous to the procedure, patients are given two hypodermics of morphine—grain one-fourth—at an hour's interval. The injection of quinine and urea is done under local novocain anesthesia. These injections are repeated every two or three days, depending on the amount of reaction the patient shows and the amount of resulting swelling in the neck. It is usual to make five or six injections into each lobe. The sites of the injections are charted on a diagram corresponding to the shape of the thyroid. It has been our practice to start at the upper pole and go down with successive treatments. Each lateral lobe is injected separately, as there is danger of suffocation from pressure caused by swelling of the gland when the injection is given into both lobes at the same time.

At the same time attention should be given to the hygiene of the mouth. Bad teeth should be extracted, pyorrhea treated, and, if necessary, the tonsils removed. As the patient improves, ligation and finally thyroidectomy are done at a time indicated by the condition of the patient. Much depends upon the experience and judgment of the surgeon at the critical time, namely, when the final operation of thyroidectomy is to be performed.

In my clinic it has been our rule to discharge the patient after a ligation of two vessels either at one or two sittings and to instruct the patient to return for observation at the expiration of two months. Usually there will be a gradual improvement for about two months after ligation, and while the improvement may continue even to recovery in the exceptional case or may remain stationary, as a rule there will be relapses at the expiration of this time. If the secondary lobectomy is postponed beyond a definite period, not to exceed in the average eight weeks, the danger of the secondary lobectomy is quite as great as though the primary ligations had not been performed. When the patient for one reason or another does not return for several months or longer after ligation, the case must be treated as though the preliminary ligation had not been performed. Two out of three of the fatalities in my series were the result of non-observance of this injunction. In these cases, when the toxicity is extreme, an attempt should be made to reduce the toxicity by rest, injection of boiling water and by ligation of the inferior poles, assuming the superior poles were ligated at the first operation, before

⁶³ Northwest Medicine, 1918, xvii, 20.

the secondary lobectomy is ventured on. The improvement which follows ligation must be due in larger measure to the section of the sympathetic fibers than to any disturbance of the blood supply. The vascular supply of the thyroid gland is so abundant from other sources that the closure of two or six vessels could not interfere very decisively with the gland's function.

Sloan states that in case the patient's pulse-rate exceeds our expectations on the table at the time of operation we do not close the neck wound; merely pack it open with paraffined gauze and put the patient back to bed. Strange as it may seem, these patients complain much less of their wound than do those in whom we have closed it at the time of operation. This is on account of lack of tension seen in sutured wounds resulting from swelling of operative traumatism. The wounds are closed under either local or light gas anesthesia in twenty-four or forty-eight hours and the patients really complain more of the secondary closure than after the primary operation. The factor of greater postoperative comfort in the neck materially lessens the intensity of the postoperative reaction.

He also offers the interesting practical suggestion that the body tissues have been depending on the secretion of the thyroid for some substance which aids in the oxidation of the waste products and that the sudden removal of the thyroid handicaps the organism until compensation takes place.

Accordingly, he administers 10 grains of thyroid extract the evening before operation and 5 grains every two hours after operation for the first day and a half. The intensity of the reaction is reduced, the cyanosis disappears in from four to six hours, and temperature and pulse-rate have a commensurate fall. Sloan believes that since instituting this procedure in the last six months he has saved 5 or 6 patients who otherwise must have died.

Laryngeal Nerve Injury in Goitre. All surgeons have probably had the mortifying experience in one or several instances of having a patient return later with aphonia. This occurrence is hard to explain to the patient, and yet is often beyond the control of the surgeon. In many cases, however, the nerve is actually injured and for this reason the two papers about to be abstracted possess great interest. Guthrie⁶⁴ states that the cause of temporary loss of voice may be put under four headings: (1) Trauma to the inferior recurrent laryngeal nerves; (2) trauma to the larynx and trachea; (3) syphilis and (4) hysteria.

Passing over the first group because every surgeon should have enough knowledge of the anatomy of the front of the neck before he operates for goitre, we will quote directly in considering the second cause.

Trauma to the trachea and larynx is followed by tracheitis and laryngitis and is frequently cause for temporary loss of voice, especially in apprehensive patients. The extent of the tracheitis varies with the amount of the trauma, and it is important to subject the trachea to the least amount of traction and injury during the delivery and the dissec-

⁶⁴ Journal of the American Medical Association, 1918, lxxi, 715.

tion of the gland. It is not wise to deliver or dissect out the thyroid in one set way. A trachea that has been encroached on by an enlarged gland will not stand the same amount of lateral pressure as one that has not been encroached on.

The surgeon should rely on the services of a skilled anesthetist in these operations, for the anesthetist's judgment of the patient's color

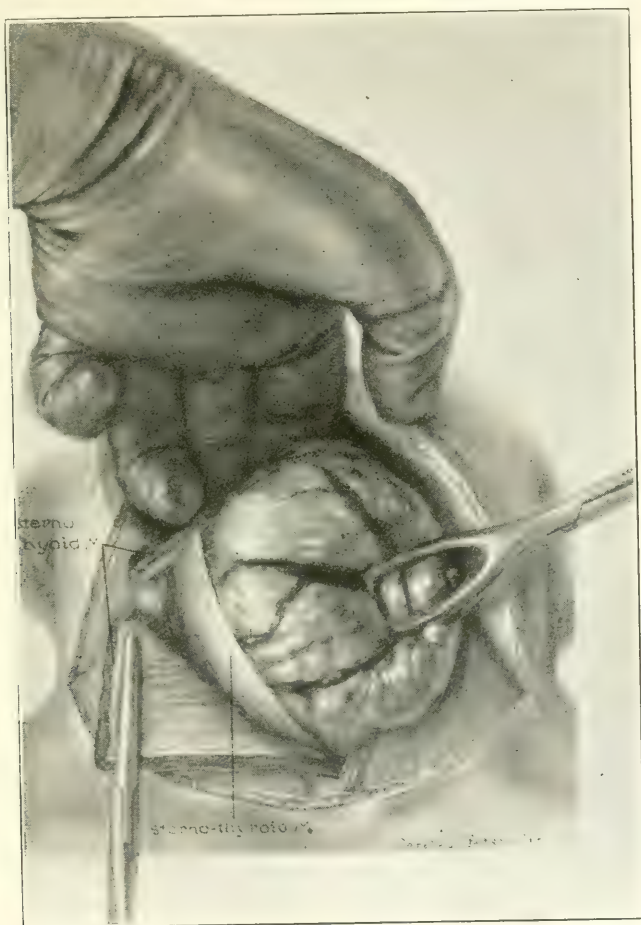


FIG. 6.—Delivery of the gland from above downward to prevent stretching of nerve. (Guthrie.)

and breathing should guide him as to just how much traction he may employ with safety or whether he should lessen the amount he is already using. To prevent stretching the nerve it is best to deliver glands from above downward whenever possible (Fig. 6). If this cannot be done it should be attempted laterally or from below upward—any way to safeguard the trachea. Substernal growths cause anxious moments until they are delivered. Substernal cysts can often be punctured with

safety and delivered easily. It is often better to begin the dissection of large colloid goitres with much lateral encroachment from the midline at the isthmus rather than laterally or from either pole. This method is more difficult and more vascular, but it saves the trachea from an undue amount of trauma. In dissecting the gland off the trachea itself it is better to leave some of the isthmus rather than to do a clean dissection down to the fascial covering. Many glands are firmly adherent to the trachea and are separated from it with great difficulty. It is an easier dissection to leave a small amount of gland on the trachea in the average case, although in the hyperplastic gland the bleeding may be hard to control. Tracheal trauma is a common cause of temporary loss of voice. It adds much to the patient's discomfort, and in the severe case it may be a factor in producing postoperative pneumonia. Free exposure is important, and it is often necessary to turn a double trap door of the sternohyoid muscles or even to cut some of the fibers of the sternomastoid to obtain it.

A laryngoscopic examination should, of course, be made in all patients before operation. Large goitres of long standing have often worked irreparable damage to the nerve and the patient can only expect continued aphonia. Guthrie says that New believes a bilateral abductor paralysis to be of syphilitic origin and that an adduction paralysis is due to hysteria.

An experimental study bearing upon this problem has been undertaken by Judd, New and Mann, from the Mayo Clinic. They studied the effect of traumatic procedures on the recurrent laryngeal nerves in dogs.

"The method of experimentation consisted in traumatizing the laryngeal nerves in a manner similar to that which could occur in an operation and subsequently to study the function of the vocal cords. The results of these traumatic procedures can only be applied specifically to the recurrent laryngeal nerves, for the results may not be the same for other nerves of a different size or in a different location.

All operations were done under ether anesthesia, employing sterile technic. The various operations differed only in regard to the traumatic procedure used. On the day following the operation the function of the cords was observed. These observations were subsequently made as frequently and over as long a time as seemed necessary in each individual experiment."

Their conclusions were as follows:

"1. Selection of the recurrent laryngeal nerve produces complete paralysis of the vocal cord of the corresponding side which in all probability will be permanent.

2. Ligation of the recurrent laryngeal nerve with linen, chromic catgut or plain catgut produces complete and probably permanent paralysis of the vocal cord of the corresponding side.

3. Stretching the recurrent laryngeal nerves acutely in a manner similar but of longer duration and intensity than occurs in operation does not impair the function of the vocal cord.

4. Stretching the recurrent laryngeal nerves for a long period, as over

muscles, impairs the function of the vocal cords, but the impairment is probably due to the operative trauma and not to the stretching.

5. Pinching the recurrent laryngeal nerves with a hemostat in a manner similar to that which may occur in an operation produces temporary paralysis of the vocal cords. Restoration of function always occurs, the length of time necessary for restoration depending on the anatomical point at which the nerve was crushed. The time found necessary for complete regeneration of the nerve when injured in the areas usually traumatized by operation varies between thirty and sixty days.

6. Exploration of the recurrent laryngeal nerves produces an effect on the vocal cords depending on the amount of trauma to which the nerves are subjected. Careful dissection will probably not produce any effect; the paralyses noted were probably due to pinching and other traumatic procedures."

Aberrant Thyroid Tumor of Tongue. It has been some time since a report of these interesting lingual goitres has come to hand. Rabinovitz⁶⁵ reports a case with myxedematous symptoms in which the tumor was materially reduced in size by feeding with mixed glands, including the thyroid. He estimates that about 70 cases have been reported up to this date. He states that "an aberrant thyroid tumor of the tongue is usually situated on the dorsum, just below and behind the foramen cecum, which it may enclose in its growth. It is, as a rule, medianly located, but may extend a little more to one side. In shape it is round or ovoid. It varies in size up to that of a small apple. In all but two cases, the tumor was encapsulated. It may project greatly above the surface of the tongue or be buried in its substance. No inflammation or infiltration of the surrounding tissue occurs. The surface is covered by the mucous membrane of the tongue, and in only one case was there ulceration. The surface is usually smooth, but if small cysts are present, it is irregular. The surface is shiny and, because of its great vascularity, has a much darker color than the surrounding mucous membrane. These bloodvessels not only cover the surface, but penetrate deeply into the tumor tissue. This rich vascularization is characteristic and explains the profuse bleeding that follows surgical or other traumatism. The tumor may or may not be movable, depending upon the duration, size and depth. The consistency varies with the histology of the growth, depending upon whether it is normal thyroid tissue or colloid, cystic, or malignant changes have occurred. Occasionally, examination, as for laryngoscopy, may be necessary to reveal the presence of the tumor and its characteristics. Bimanual palpation, with one finger in the mouth and one beneath the jaw, should never be omitted. This procedure is absolutely painless because of the insensibility of these tumors. If the tumor is very large, it can be felt below the inferior maxilla, and may be mistaken for enlarged submaxillary glands."

The *symptoms* are not marked unless the growth is large, when obstruction to the esophagus or epiglottis may ensue, with the attendant

⁶⁵ Surgery, Gynecology and Obstetrics, 1918, xxvii, 191.

phenomena of difficult and painful swallowing, cough, or even suffocation. Many have a desire to "swallow the tumor," and there may be increased salivation and thickness of the voice. Thyroid insufficiency may show itself, and especially after removal if this is the only available thyroid tissue.

The *prognosis* is favorable, and the best *treatment* is by operation. Thyroid feeding should be attempted and may result in a marked decrease in size, as has been observed in the author's case. Local treatment is without avail. Puncture may result in profuse bleeding, or infection with an increase in the size of the growth. Removal by galvanocautery leaves behind parts which regrow. The best operation is incision with enucleation, either by way of the mouth or through the suprahyoid region. Indications for removal depend upon the size of the tumor and the amount of interference with respiration and deglutition. Removal should be promptly followed by thyroid therapy on the first indication of hypothyroidism. Five cases operated on are reported to have developed myxedema and 3 to have recurred. Three cases are reported to have died without operation. One of these was a stillbirth, one died soon after birth of asphyxia, and one died at the age of six months of cretinism. Two were accidental postmortem findings, and had nothing to do with the cause of death.

THE NECK.

Tuberculous Glands of the Neck. Dowd⁶⁶ has now had 726 cases. Last year I reviewed his report of 687 cases and this one adds nothing new. He again calls attention to the favorable *results of surgical treatment* in early cases, particularly children, and to the lack of attention to technicalities on the part of some. The following is worth quoting:

RECURRENCES IN LATE AND UNFAVORABLE CASES. "Those who mainly see late and unfavorable cases will find so many recurrences that they will not be enthusiastic about the operation. There should be a fair number of children in every large group, otherwise one has not the right conception of the value of the operation. Particularly, one should not be discouraged by the unfavorable cases, and hence withhold from the early cases, especially the children, the quick cure which operation is likely to give. Individual surgeons, whose experience is largely with adult patients with extensive tuberculosis, naturally do not become enthusiastic over the treatment. Recurrences are discouraging, and operation in some of these advanced cases is very tedious, but these are not the cases whom this discussion concerns. We are studying the children and it is not fair to deprive them of the advantage of early operation because patients of an entirely different class have recurrences. Those who see the good results in children, and in favorable adults, must be enthusiastic about them.

At least three other kinds of treatment are often considered: (1) Constitutional; (2) x-ray; (3) tuberculin.

⁶⁶ New York State Journal of Medicine, 1918, xviii, 109.

I have studied all of them with very great interest, and have visited various institutions where they were in use and have seen the results, and I can see no reason for advocating long periods of treatment which give uncertain results when there is a simple short treatment which gives such good results, excepting in those cases of diffuse tuberculosis, for whom radical removal is impossible or very difficult.

I would advocate the best hygienic and constitutional measures which can be obtained, but so many of my cases have lived in unsanitary tenement-house surroundings that I have had the opportunity of seeing what surgery can do without hygienic help.

Yet we often have patients brought for consultation with the story of months, and even years, of treatment, and the entire family has been enslaved by the kind of treatment which has been used. They have gone south in the winter and north in the summer; the patient's tonsils have been removed, *x-ray* has been tried, vaccination, out-of-door life, and various other forms of treatment, and the patient is finally brought with the request that something else should be done before operation is resorted to. This fear and suspicion of surgery are brought about by a misapprehension of what surgery will do, and it is not fair to let the misunderstanding exist."

X-RAYS IN CERVICAL ADENITIS. We have generally condemned the use of the *x-rays* in the primary treatment of tuberculous glands of the neck. It is undoubtedly true that many enlarged nodes in children are not tuberculous, although considered as such, but are simply a hyperplasia reacting from a primary focus of infection. Removal of this focus will often of itself cure the adenitis, and such cure will be hastened by *x-ray* treatment. The typical moderately advanced "tumor" seen by the surgeon, consisting of a chain of fused glands is best treated, we still believe, by operative interference; this method offering the best chance for a quick cure with an inconspicuous scar. We see the end-results of *x-ray* "cures" in the form of soft collections requiring incision and drainage and a mean scar. Pfahler,⁶⁷ in an excellent paper, advocates their use and states that "the Roentgen rays can be expected to relieve completely the early cases. After operation, treatment should be given to prevent recurrences." He rightly emphasizes the necessity for skillful technic whether it be surgical or roentgenological, and believes that no one should undertake treatment without a good machine, careful study and a reasonable amount of experience. He proceeds as follows:

"*Technic of Roentgenotherapy in Cervical Adenitis.* In general, the technic of deep roentgenotherapy should be applied in this disease. Therefore, it is my technic at present to employ hard rays thoroughly filtered, that is, I make use of rays from a tube which will back up a nine-inch parallel spark gap, which is equivalent to approximately nine on the Benoist scale. These rays are filtered through 6 mm. of aluminum. I apply these rays for 40 ma. minutes through each portal of entry. The hair and face must be thoroughly protected by sheets of lead. The focal distance from the target to the skin is 8 inches.

⁶⁷ New York State Journal of Medicine, 1918.

The number of portals of entry will vary somewhat with the individual case. In general, however, two portals of entry for one side of the neck will be sufficient. In very severe cases or when the glands are very large it may be necessary to divide the portals of entry on one side of the neck or on each side of the neck into four or more. I generally draw lines downward along the anterior border of the sternocleidomastoid muscles and then direct rays anteriorly through the neck, and then posterior to this line toward the deeper portion of these glands. This treatment is not repeated again for a month, at which time one will find usually a very decided reduction in the size of the glands, and in not repeating inside of a month one avoids cumulative effects and a dermatitis.

A dermatitis should always be avoided, especially in the treatment of this disease; even a redness of the skin should be avoided."

The *history of the development of x-ray therapy for tuberculous glands of the neck* is ably presented by Pfender.⁶⁸ Based on "personal experience and study of more than 2240 cases," he concludes that roentgenotherapy offers the best results of all the remedial measures now known for the treatment of all forms of this disease. Ten "selected" cases are used to prove the point. It is not noted whether the study of 2240 cases was from the clinical or literary standpoint. However, even this large number may be attained by one observer, because Boggs⁶⁹ states that "in some clinics more than 1000 cases of tuberculous adenitis have been treated by roentgenotherapy, and operation was required in less than 10 per cent. of the cases, even for the removal of the fibrous nodules, over 90 per cent. being caused by radiation alone."

Atlas and Axis Luxation. I have several times in the past referred to dislocations high in the neck. This year we have an interesting contribution by Jacobs⁷⁰ who reports 3 cases of dislocation of the atlas not complicated by fracture of the odontoid process of the axis and without the usual history of traumatism. After describing the varieties encountered, he asks, is it so essential that in dislocation of the atlas the integrity of the odontoid process be preserved? If otherwise, will the penalty finally be paralysis or death? In answer to these, he states that the evidence, as derived from the reported cases, does not prove such to be so. In 30 cases of dislocation of the atlas and axis collected by Jacobs, exclusive of Corner's cases, 24 were of the atlas and 6 of the axis. Death occurred in 1 almost instantly, and in 2 other cases in six months and thirty-two years, respectively. In 5 cases paralysis occurred. The odontoid process was fractured in only 7 cases without causing death or paralysis, except in 1 case, while it was intact in 23 cases; of these, 2 were fatal and 4 developed cord symptoms.

In 1916, Jonas⁷¹ reported a case of luxation of the neck following osteopathic "treatment;" the first of Jacob's cases had a similar etiology which, fortunately, was reduced by traction after about four weeks.

⁶⁸ *Medicine and Surgery*, 1918, ii, 400.

⁶⁹ *American Journal of Roentgenology*, 1918, v, 425.

⁷⁰ *American Journal of Orthopedic Surgery*, 1918, xiv, 357.

⁷¹ *PROGRESSIVE MEDICINE*, March, 1917, p. 64.

The 2 other cases reported by Jacobs are intensely interesting, and represent examples of an almost new entity, *viz.*, luxation resulting from acute infection which is not associated with trauma. Jacobs believes that such a theory is logical in view of the fact that spontaneous dislocation of the hip may and does occur as a sequela of typhoid fever, and that these dislocations resemble those which are traumatic in their occurrence. According to this supposition, then, distention and relaxations of ligaments as a result of toxins can be productive of a dislocation.

Concerning the pathological changes existing in distention luxation, but little is known from direct examination, as no opportunity has been offered for studying such changes. It is probable that the same observations may be applied to this dislocation as to spontaneous luxation of the hip following acute infectious diseases, in that it is the presence of effusion into the joint which distends and weakens the ligaments. The slightest movement of the head, then, would be sufficient to produce a separation and slipping of the articular processes. The dislocation would now be similar to that found in traumatic dislocation, but, unlike the latter, the rupture of the transverse ligament or fracture of the odontoid process would not occur.

Distention luxation inaugurates its attack with fever, headache and pain referred to the base of the neck, which is particularly striking during the defervescent stage of the fever. During this stage, or shortly afterward, the muscles of the neck become rigid and the head now assumes the vicious position. Otherwise the symptoms are the same as those resulting from trauma. Pressure symptoms, and even death, may be anticipated in the occasional case, but as yet they have not been observed.

The first case reported was attacked with symptoms suggestive of spinal meningitis. There was headache, vomiting, fever, etc. Spinal puncture proved negative, and the fever subsided in about a week.

At this time there was pain referred to the nape of the neck. About a week after this, the head was held rigid and tilted backward. Later the head was tilted to the right side and of late it had been held forward with the lower jaw protruding. The muscular rigidity is less in the morning when first arising than at a later period of the day. In the past three days, he has complained of headache, which is worse after lying down.

Examination. The head was held forward and downward with the lower jaw protruding. Motion of the head was not possible and any attempt at movement caused much pain. In looking upward or downward, the eyes followed as far as possible in either direction with no movement of the head, and in looking to the side the shoulders and trunk rotated in place of the cervical spine. The lower jaw protruded beyond the upper one; the mouth could not be opened more than one-half inch because of the muscular rigidity and pain, and the front teeth in the lower and upper jaws did not approximate. The voice had a nasal twang. Otherwise no other abnormal findings were observed.

Roentgenograms were suggested, but it was not possible to take them because of the position assumed by the child when lying down.

Diagnosis. The physical examination of the patient easily might have led to a diagnosis of cervical spondylitis, but the history of acute onset ruled this out. Dislocation of the atlas was not suggested merely because there was no history of traumatism. Retropharyngeal abscess, due to acute infection, was the tentative diagnosis.

Under anesthesia, the muscular rigidity disappeared and free movement of the head was possible. It was noticed that in hyper-extending the head, the lower jaw no longer protruded, and the lower teeth approximated with those of the upper jaw; but, if the head was tilted forward, the lower jaw would again protrude. No abscess could be felt in the pharynx, but particularly striking to touch was a prominent vertebral body. Roentgenogram showed that when the head was tilted forward, there was a subluxation forward of the atlas, but that when the head was tilted backward the atlas was in its normal position.

Treatment. With the head in hyperextension, a Calot plaster jacket was applied, which was worn for two and one-half months. During this period the child was free from pain and discomfort, and was up and about as usual. Shortly after this the head was found freely movable, and the roentgenogram showed complete reduction of the atlas.

The second case was similar to the above. Two other cases were found in the literature. He concludes:

1. Dislocation of the atlas and axis must no longer be considered of rare occurrence. In fact, many cases of suddenly acquired rigid neck associated with abnormal position of the head, which cannot voluntarily be corrected, are probably subluxation of the atlas.

2. The reported cases of distention luxation seem to supply the links in the etiological chain which prove beyond a doubt that clinically there is a distinct affection resulting from acute infection which is not associated with trauma.

3. In traumatic dislocations the severity of the symptoms, as well as the prognosis, is governed by or is proportionate to the amount of force of the traumatism and the resulting pathology. Force great enough to fracture the axis need not necessarily produce dangerous compression symptoms or prove fatal, if sufficient support and time are afforded for repair to take place. Again, force great enough to fracture the axis, if applied to the atlas, would not only cause a dislocation, but would prove fatal because of the great compression such force would produce. If, on the other hand, the dislocation of the atlas is the result of a lesser force, the striking feature is the comparatively mild symptoms resulting.

4. The treatment of distention luxation is in no way different from than in traumatic luxation: After the diagnosis is definitely determined then extension by weight and pulley will relieve the pain and overcome muscular sensitiveness, and in most cases will overcome the luxation.

5. The method of reduction by manipulation under anesthesia is not without danger in either distention or traumatic luxation. On the other hand, manipulation without anesthesia is valueless.

6. The most essential feature, after reduction has been accom-

plished, is the immobilization of the head until the ligaments have had time to retract or unite, as the case might be.

7. Operative procedure, as devised by Mixer, is advisable when reposition of the vertebra has not been accomplished by other methods.

Torticollis. The subject of wry-neck is mostly presented to us through the medium of the German literature, and hence the very complete review by Fisher,⁷² although rather old now, is worth recording, it having previously escaped my notice. After a brief historical review, he discusses the anatomy:

Ordinarily we think of the sternomastoid as a muscle running from the mastoid process downward, inward and forward, as one fleshy belly that divides into two below, one portion being attached to the upper part of the sternum and the other near the inner end of the clavicle. Ordinarily the clavicular portion is the larger. Variations in the muscles occur. Sometimes there is no division in the belly of the muscle—it extends as one from the mastoid to the sternoclavicular region. On the other hand, two distinct muscles may be present, one running from the mastoid to the sternum, and the other from the mastoid to the clavicle. In certain of the mammals this is a normal condition. The space between the posterior border of the sternomastoid and the anterior border of the trapezius is very variable, and there may be muscle fibers continuous throughout, making a sort of third muscle or uniting the trapezius and the sternomastoid.

In general, the blood supply enters the upper part of the muscle and runs downward and parallel to the muscle fibers. The vessels are either anatomical or functional end arteries—they are not anatomical one with the other. The nerve supply is from the eleventh cranial (spinal accessory) and from branches of the cervical plexus.

Function of the Sternomastoid. Contraction of the sternomastoid on one side flexes the head laterally toward the side on which the muscle is acting—at the same time it raises the chin and turns the face toward the opposite side. When the muscles on two sides act together the head is somewhat raised as the points of insertion are posterior to the axis on which the head rotates. When the head is held still the muscles raise the clavicles and act as accessory muscles of respiration.

The best evidences seem to show that the pathological process in torticollis is a primary degeneration of the muscle fibers followed by an increase in the connective tissue.

Etiology. This is the most interesting phase of the entire subject and one that has caused an enormous amount of controversy.

There are four main ideas as to the origin of wry-neck:

1. Traumatic.
2. Infectious.
3. Intra-uterine origin.
4. As a most important subdivision of intra-uterine ischemia of the muscle.

The traumatic theory was first definitely formulated and announced

⁷² American Journal of Orthopedic Surgery, 1916, xiv, 669.

by Stromeyer in 1830 and held its sway for about fifty years, and was accepted without comment by nearly all the men whose names were great in surgery during that period. He stated that the cases arose following a difficult labor—one with abnormal position or with forceps extraction. He cited four such cases—tearing of the muscle with swelling, hematoma and gradually fibrous repair, leading to hardening of the substance and shortening of the muscle. The first to contradict this idea was Petersen, in 1884, who announced that Stromeyer's idea could not be right; that wry-neck never came from a tear in the muscle, and that the whole idea was most improbable. Following this, there appeared many articles on both sides of the question—most of them upholding Stromeyer. Among others it is interesting to note one by Volkmann, interesting in view of the ischemic theory of origin.

The intra-uterine origin, resulting from cramp of the muscle from abnormal position of the head has many advocates, and the following have been adduced in its favor:

1. There are many congenital cases reported where there is no special birth trauma: Whitman, 32 out of 264 cases; Redard, 18 out of 70 cases.

2. The combination of wry-neck with other congenital deformities, such as high-shoulders, congenital dislocations, hare-lip, hypoplasia of genitals, club-foot, subluxations of the hand (Madelung's deformity), defects in radius, facial paralysis, defect in the pectoralis major, etc. It is most frequently combined with congenital dislocations and high shoulder-blades.

3. Hereditary influence, as evidenced by family disease. Most frequent relationship is that of mother and daughter, but all relationships have been observed, including that of father and son. (Question of true heredity or pressure.)

Phocas⁷³ says that it is due to fetal rachitis (but the evidence is not good).

4. The histological findings as already noted.

5. Asymmetry of the ears caused by pressure, particularly a little groove in the lobe, which could not be caused by birth trauma.

The ischemic theory was first advanced by Volker: He observed a notch in the ear on the affected side. This notch he concluded was caused by pressing the head laterally against the shoulder, and turning the lower part of the ear upward. The pressure of the head against the shoulder also shut off part of the blood supply of the sternomastoid, particularly part of the arterial supply, and prevented return of venous blood. A nervous congestion results. The theory, however, has been attacked. More recently, the infectious origin has been discussed, and wry-neck is believed to be a chronic inflammatory myositis.

Secondary Skeletal Alterations. Two groups have been differentiated. The first has the entire head drawn to the right side and the cervical vertebra drawn to the right, and a cervical scoliosis with the convexity to the left. The left shoulder blade is about three times as far from the dorsal spine as the right, and is much more prominent. There is an

⁷³ Rev. de Orth., 1894.

increase in the bending forward of the angle of the ribs of the left side. There is a left-sided dorsal scoliosis (convexity to the left) and very little curve in the lumbar region. The curves in the cervical and dorsal region are continuous.

In the second form the head inclines to the affected side, but is dislocated as a whole to the unaffected side. The curves thus produced are different. There is a cervical scoliosis with the convexity to the unaffected side, and a thoracic curve with the convexity to the affected side. In the first case the curves are in the same direction, in the second case in the opposite direction.

Lorenz considers the second type as a compensatory scoliosis, comparable to habit dorsal scoliosis—the cervical scoliosis is compensated by a bending in the occipital-atlantal joint. He applied the name occipital compensation of cervical scoliosis.

The first form is a cervical scoliosis without occipital compensation. The second form is a primary cervical scoliosis, with a partial compensatory occipital scoliosis and also with compensation below.

Plexus paralysis is one of the less common secondary consequences of wry-neck, and is due to the pull on the plexus from the head or the arm. It may occur at birth or arise later.

Diagnosis. This is usually easy. A lateral flexion of the head may be noted after difficult labors but it soon clears up. Rotary luxation is diagnosed by the line of the spinous processes, by mouth examination and from the nervous symptoms. In Pott's disease the head is held to one side, but not turned to the opposite side; the history and palpation through the mouth are also important. Cervical rib at times offers difficulty.

Other forms of wry-neck are: Bony; from eye defects; from defects in the ears, particularly suppurative; from enlarged lymph nodes; from goitre and other tumors; from skin affections; and, finally, the rheumatic.

Treatment. The older treatment was with apparatus, many kinds of which have been devised. All of these are inefficient. Lorenz has used forcible redressment by placing one hand on the head and the other on the well side of the neck, and making forcible manipulations. This is a dangerous procedure, and has caused several deaths, as well as tearing of the vessels and nerves. The operative treatment consists in either subcutaneous tenotomy or, better, an open operation, severing all the fibrous bands of the sternomastoid that keep the head in its abnormal position. Sometimes it is necessary to sever part of the trapezius and of the scalenus anticus, which is a rather difficult procedure. Occasionally the entire sternomastoid is removed, as recommended by Mikulicz. Occasionally the incision is made above to prevent the adherence of the muscles to the surrounding parts and the reproduction of the deformity. Various plastic operations on the muscles have been used, but these are not as good as simple division. Wullstein, instead of dividing the affected muscle, operates on the unaffected muscle by shortening it, hoping thus to overcome the deformity.

Following any operative procedure, the head should be held in plaster

of Paris for two to four weeks, and then passive and active motion should be begun.

An extensive bibliography accompanies the article.

CANCER OF THE BREAST.

End-results of Operation. Statistics may be misleading but they are always interesting when they represent the experience of a single operator. Buchanan⁷⁴ tabulates the results of operation for cancer of the breast in 153 cases traced for a period of at least three years after operation.

Fifty-five patients are known to be now living and well, or free from recurrence when last heard from (in no case less than three years after operation). Three patients are known to have died from non-cancerous disease more than three years after operation, making 58 cases in all.

Eighty-five patients are known to have died of cancer; 3 from the operation; 7 from causes unknown; making 95 in all.

Cases cured to or beyond three years	58
Cases not cured to or beyond three years	95
Total	153
Cured for three years, or longer, 38 per cent.	

If we set the arbitrary limit of a cure at five years instead of three we have, of course, a much less favorable showing:

Cases cured to, or beyond five years	36
Cases not cured to, or beyond five years	117
Total	153
Cured for five years or longer, 23.5 per cent.	

Nineteen of the patients are living, ten years or more after operation. There were 3 operative deaths, a mortality of 1.5 per cent. but one woman, aged eighty-four years, was operated on under local anesthesia and died at her home five weeks later. The total number of operations was 204, but 51 could not be traced.

"Variations in the method of operation in the cases recorded were made from time to time, but the end-results do not seem to have greatly differed.

The principles adhered to have been (1) to widely circumscribe the affected area; (2) to completely extirpate all glands and fat in the axillary and postaxillary spaces; (3) of late years to remove the pectoralis minor and the pectoral portion of the pectoralis major muscles; (4) to coapt the skin edges without injurious tension; and (5) to cover raw surfaces with Thiersch grafts from the thigh, when necessary.

Various lines of incision have been employed, but an ovate-acuminate figure has been preferred. This starts at the insertion of the pectoralis major, passes parallel with, and above, the rounded border of the pec-

⁷⁴ Pennsylvania Medical Journal, 1918, 623.

total, circumscribing the breast with its diverging lines, which meet and are continued toward the midline like the stem of a leaf."

DELAY IN DIAGNOSIS AND TREATMENT. Simmons⁷⁵ undertakes to determine the reason for procrastination in cancer of the breast and, while he presents no conclusions, his findings are of interest. The first symptom noted in 151 out of 167 cases was tumor; pain, retracted nipple, discharge, etc., were rarely first noticed. Thirty-three per cent. of the cases sought treatment on the first appearance of symptoms and 44 per cent. inside of two months, but the other 56 per cent. brought the average up to 12.5 months of delay.

RECURRENCE AFTER OPERATION. Eighty-five of the cases seen at the Collis P. Huntington Hospital were inoperable postoperative recurrence. The recurrence was local as well as general in 76 out of 81 in which the site was stated. The average length of time from operation to the appearance of recurrence was not noted until over three years from the date of operation, and in 6 per cent. over 5 years. All of these cases had a local, as well as a general, recurrence. These figures show the fallacy of calling a cancer of the breast "cured" if it has remained well over three years from the date of operation.

Jacobson⁷⁶ summarizes the end-results for the radical operation as shown in the literature for the past ten years. Of 3462 cases operated on, 1866 were traced. Of these, 32.86 per cent. were well after the three-year period, and 23.77 per cent. at the five-year period.

TOTAL EXCISION OF THE PECTORAL MUSCLES. This has been a moot point among surgeons, particularly as the late Dr. Murphy was inclined to leave part of the muscles, fearing crippling of the function of the arm. Meyer⁷⁷ urges their removal, and describes in detail the technic of his operation, probably familiar to all surgeons. He urges the complete excision of both pectoral muscles from their insertion to their origin, as an additional safeguard not only against local and regional recurrence, but also against metastasis. He believes that the preservation of the clavicular portion of the major pectoral muscle makes but little difference in the cosmetic result. He also considers it inadvisable to preserve portions of the muscle for the purpose of covering the brachial nerve plexus and the large bloodvessels, in order to try to avoid, by such procedure, the later appearance of neuralgia and edema of the arm; he has rarely seen persistent neuralgia subsequent to the radical operation. Should chronic edema set in later, it can be overcome by dividing the deep fascia in a number of places. (Kondoleon's operation. See Sistrunk.⁷⁸) In the discussion on Meyer's paper, Erdmann stated that he would have to place himself in the list of those who did not remove all the pectoralis major and not the pectoralis minor once in ten times. He stated that he had given this matter much study in the way of following his patients and that he had never seen a metastasis occur in the portions left of the major or minor pectoralis in over twenty-five years'

⁷⁵ Boston Medical and Surgical Journal, 1918, clxxix, 639.

⁷⁶ Ohio State Medical Journal, 1918, xiv, 524.

⁷⁷ Annals of Surgery, 1918, lxviii, 17.

⁷⁸ Journal of the American Medical Association, 1918, lxxi, 800.

practice unless the muscle, that is, the pectoralis major, was already involved at the time of removal of the breast. Those metastases which he has found have been osseous, with the exception of shotting of the skin or possibly a metastasis occurring in a gland left in the axilla. He also stated that in considering cases coming to him originally operated upon by other surgeons he could not recall a single case in which the metastasis had occurred in the portion of muscle remaining. He stated that he had seen Meyer do this operation many times, and has as frequently heard him say that he left a portion of the pectoralis minor as a stump on which to graft the skin.

Franz Torek stated that he had time and again found a number of affected glands under the pectoralis minor muscle of such character that they would not have been discovered or suspected unless the pectoralis minor had been removed, and, quite apart from the question whether or not the pectoralis minor might be affected, he considered this a strong indication of the advisability of always removing the pectoralis minor muscle; otherwise there is a certain portion of the gland chain running along the vessels that cannot be thoroughly exposed. He said that he had seen 1 case in which a stump of the pectoralis major left behind by another surgeon at its insertion into the humerus was the seat of a recurrence. This one case has proved to him that even a remnant of the pectoralis major where it is attached to the humerus, may be a menace, and he is therefore a strong advocate, not only of partial, but of extensive, removal of both pectoral muscles.

Dean Lewis stated that he considered Meyer's paper well timed in view of a tendency during the last few years to recommend operations in cases of cancer of the breast which are incomplete. These incomplete operations are followed by a greater number of and quicker recurrences. This statement applies particularly to the use of a part of the pectoralis major muscle as a flap to cover vessels, with the idea of preventing edema of the arm and limitation of motion. The incomplete operation without removal of the muscles is based on the statement of Bryant, of London, that he had never seen recurrence in the pectoralis major when the fascia covering it had been removed. Lewis considered this to be a fallacy. In all cases of carcinoma of the breast he advocated the removal of the sternal part of the pectoralis major, and stated that the pectoralis minor muscle should always be removed if a complete dissection in the axilla is to be made, because of the frequency with which Rotter's lymph nodes are found. He stated that the loss of motion in the arm is due to a poorly planned flap and that in all cases good motion can be secured by making an axillary flap in cases of carcinoma of the breast.

In *PROGRESSIVE MEDICINE* for March, 1915 and 1918, there will be found a discussion on this same point.

X-rays in Cancer of the Breast. Saberton⁷⁹ concludes that x-ray treatment should be begun as soon as possible after operation. It is essential to administer large doses of x-rays, and the rays are measured after filtration through 2 or 3 mm. of aluminum. The scar area, axilla,

⁷⁹ British Medical Journal, 1918, ii, 337.

supraclavicular and postscapular areas should all be treated. With careful technic these doses can be repeated to the same skin areas once a fortnight. This method of cross fire enables a large quantity of raas to reach the mediastinum. The radiation is greatly facilitated by the introduction of the Coolidge tube. In ordinary cases the first course of treatment lasts about three months. A second shorter course is given after two or three months, and subsequent radiations are administered at gradually lengthening intervals. The patient is kept under observation for two or three years following the date of the operation.

The general conclusions arrived at from treatment of cases in this group are as follows:

1. The patients are less likely to have a recurrence of the disease than cases not so treated.
2. Local recurrence in the scar area is rare.
3. Supraclavicular deposits do occur, but can as a rule be controlled. These deposits never break down or ulcerate.
4. Mediastinal recurrence appears to be less frequent.
5. The general health of the patient is improved.

Saberton draws attention to two rare conditions which arise as a result of radiation. They are: (1) Late *x*-ray reaction, when the skin and subcutaneous tissue become very tough and finally slough. This may develop weeks or months after patient has ceased treatment, and is very painful and slow to heal. (2) Anemia, which is probably of the same type as that which sometimes develops in *x*-ray operators, as it is known that *x*-rays have a profound effect on the blood. In inoperable cases, therefore, *x*-rays are of undoubted therapeutic value. Life is prolonged, and growths robbed of their most distressing features; pain is relieved or alleviated, secondary infected glands can be controlled and prevented from ulcerating, and the primary growth often shrivels or remains *in statu quo*. Inoperable growths occasionally become operable and the mental comfort derived by the patient would alone justify the treatment. In some cases Saberton considers that surgeons might with advantage employ electrothermic coagulation.

Boggs⁸⁰ uses a Coolidge tube and a modern transformer, focal-skin distance 8 inches, filtering the rays with 4 mm. of aluminum, with a 9 inch parallel spark gap, 25 ma. minutes are given. With most transformers this dose will measure 20X Koenig (Gauss modified Kienbock scale). This is the dose he employs in most cases, and he rays the following areas:

"1. In order to prevent recurrence in the wound and destroy any foci in the lymphatics of the anterior chest wall and those leading up to the inner clavicular area, three to four areas receive treatment, the last being directed toward the liver. Then the liver area is given one anteriorly, one laterally and one posteriorly. With this amount of treatment, the scar is nearly all removed and a recurrence in the area is rare, in comparison with the number of recurrences in cases not treated by radiation. The scar will not tolerate as much radiation as regions where the circulation has not been interfered with by operation.

⁸⁰ American Journal Roentgenology, 1918, v, 301.

2. The axilla is given from three to four doses, in addition to what it receives indirectly while other areas are treated, so that it will receive a full dose at the proper depth. One area below the axilla laterally can be covered by one treatment. The supraclavicular glands are usually involved from the axillary.

3. The supraclavicular region is divided into four areas. One treatment is directed obliquely inward including the lower cervical glands, one downward through the shoulder area to the axilla, one obliquely downward and backward through the clavicle, and one obliquely forward and downward from the posterior surface. Care must be taken that the glands under the clavicle receive a full dose.

4. The suprascapular area much more frequently discloses metastases than the subscapular. Each should receive a full dose on the affected side, while on the opposite side the subscapular area might be omitted in early cases.

5. The mediastinum should receive one or two treatments from the posterior to an area between the spine and scapula of the opposite side directed toward the affected breast region, besides the treatment it receives when other areas are rayed.

6. The opposite side is rayed according to indications, and during the course never receives less than from four to eight treatments.

7. The epigastric region must never be omitted, as this is one of the avenues by which the liver and pelvic viscera are invaded.

The interval between the first and second course of treatments is four weeks. However, in most cases the supraclavicular glands are rayed again in two weeks instead of four, since this chain is often involved, and the surgeon seldom advises opening it, because he has learned that it is really inoperable when involved. Competent surgeons agree that if an operation could be performed before a diagnosis could be made clinically and without a microscope, 80 per cent. of the cases could be cured."

Pfahler⁸¹ believes that in postoperative treatment we have the greatest field of usefulness of *x*-rays. This postoperative treatment should be given thoroughly by a competent roentgenologist, and as soon after the operation as the patient can be moved for treatment. He hopes later to be able to prove by statistics that the end-results of operation (at least on advanced cases) can be doubled provided thorough postoperative *x*-ray treatment is given. If that is true, then *x*-ray treatment is just as important as the operation itself. He has seen masses of recurrent malignant disease disappear under active *x*-ray treatment. That proves beyond all doubt that *x*-rays have a pronounced influence on malignant disease. It is reasonable to assume that if the disease can be made to disappear after it has reached microscopic size, and after nutrition is being supplied by the development of bloodvessels, the same malignant cells should respond to *x*-ray treatment much more readily when it is microscopic in size and before it has fully developed.

In all this discussion it is to be assumed that we will be permitted to

⁸¹ American Journal of Obstetrics, lxxviii, 124.

treat the disease while it is yet localized in the neighborhood of the breast and the axillary glands leading therefrom. At least, that it is still confined to the chest for, of course, x-rays cannot be expected to influence the disease to which they have not been applied. He has demonstrated the healing of disease even after it has extended to the spinal column, but when the disease has extended so far, one must assure that it is general and complete recovery can hardly be hoped for. Even when the disease extends to the mediastinum it can be influenced favorably, though the patient may not get completely well. He has a patient under his care now who was referred five years ago for treatment of mediastinal disease which developed after the removal of both breasts for carcinoma by the late Dr. Rodman. The patient is not yet cured, and probably never will be, but she is free from symptoms, and is attending to her normal household duties.

He has had a number of cases referred by surgeons for treatment of these benign tumors. They were believed to be benign and, so far as he knows, none of them has developed into malignant disease since. These tumors have practically all disappeared under treatment. He does not advise against operation, but this is one of the methods of treatment to be considered if the patient cannot be operated upon.

He brings out a third thought which is comparatively new. During the past year he has been recommending, and using in a number of cases, a thorough course of deep x-ray treatment which requires several days to administer, and which is given especially in the advanced cases, and is to be followed within a few days or a week by operation for the complete removal of the malignant tissue. Experimental work has shown that the power or reproduction of malignant cells is much decreased by x-ray treatment, and it is upon this theory that he assumes that if the patient is given a thorough course of treatment, such as would be given if one expected to cure the patient by x-rays, that the malignant cells will be so influenced that there will be less tendency to recurrence or metastasis. The operation should then be followed by further x-ray treatment given four weeks after the first course of treatment is given.

Radium in Cancer of the Breast. Tousey⁸² describes two distinct effects from the application of the radiation from radium which are obtained by slightly different methods of application. The destructive effect is characterized by the death of tissue and its extrusion as a discharge or scab. It may be accompanied by redness, pain and suppuration if the application is made to a region where the skin is thin and vascular like the normal integument of the back of the hand. This effect of radium with suppuration is employed in recurrent cancer of the breast when there are ulcerated areas of moderate extent and apparently of a superficial character. A glass tube containing 20 mgm. of radium having a radio-activity of 2,000,000 is applied for about half an hour to an area about half an inch in diameter and without interposition of any filter except the thinnest rubber to prevent contamination of the glass tubes. Half an hour constitutes the complete treatment for the

⁸² Texas Medical Journal, Nov., 1917.

half inch area. A few days later a condition of moderate inflammation begins. This commences to subside about the seventeenth day and by the thirtieth day a crust has come away, leaving a healed and apparently healthy surface. An alternative effect may be produced by a single application as above described but of twenty minutes' duration. Repetitions may be required to prevent recurrences. As an adjunct to radium in the treatment of recurrent cancer of the breast, *x*-rays, generally applied to the axilla and the front and back of the chest, are employed. Another is the *x*-ray examination of the teeth, where the seat of infection in cancer is frequently found in the form of dental abscesses. This should be treated with autogenous vaccines.

HODGKIN'S DISEASE.

End-results in Hodgkin's Disease. Morter⁸³ read a summary of 93 cases, treated by Yates, before the Surgical Section of the American Medical Association. Of these, 63 were reported by Yates and Bunting previously, and the treatment carried out was that described by them in the literature of recent years. Hodgkin's disease and a group of allied affections were considered a non-communicable, infectious granulomatous process due to the *Bacillus hodgekini*, and partook in effect of the destructive potentialities of both a malign infection and a neoplasm. The treatment prescribed was the detection and elimination of the portal, or portals, of entry, followed by complete and extensive surgical removal of as much accessible pathological tissue as circumstances would permit, aiming to rapidly place the balance of power on the side of individual resistance. All surgical procedures were promptly followed with *x*-rays and repeated from time to time. *X*-rays were considered a valuable adjunct to treatment if applied judiciously. The dose and application were measured by frequent blood counts, the actual lymphocyte curve being the index. Immune serum was employed as a routine in all cases because seemingly more uniform, and better results were obtained with its use. General hygiene and prolonged rest should be employed to maintain results. No special form of medication had proved of any value, and, except for tonics and the like, no other drugs were used. Apparently there was a fairly distinct line separating a possibly curable and an incurable condition in Hodgkin's disease. On one side, curable, there was an apparent absence of demonstrable deep involvement; on the other, incurable, its presence. In the potentially curable group there were 26 cases reported.

Taking the fifth successive year of clinical freedom from all evidence of disease as the earliest period upon which to base any valid claims of recovery, 7 cases were reported as such; 2 were of ten years' duration since inception, 1 of nine, 2 of eight, 1 of seven and 1 of six years; 1 case (duration five years) fell in the three to four years' period; 2 (duration two and a half and three and a half) in the two or three-year period; and 5 cases (duration two to four years) in the one to two-year period.

⁸³ New York Medical Journal, June 22, 1918.

Periods of freedom of one year or less were of no value as prognostic evidence. Of these 26 cases, apparently the only types where recovery was possible, there were 5 deaths; 1 of these patients discontinued treatment and 1 refused to begin. Thus the actual mortality rate was less than 12 per cent. to date, and fair estimate as to the probabilities of recovery was 70 to 80 per cent. In the later cases, except where lethally involved, much could be done in the way of prolongation of life and comfort, life having been prolonged in one instance eight years. The interim between a potentially curable condition and a hopeless widespread invasion might be only comparatively short. This accentuated to the utmost the importance of early diagnosis and treatment. To obtain lasting results it was necessary to follow the patient for years with appropriate treatment until the blood picture returned to normal. The paramount factor was early diagnosis followed with adequate treatment. Hodgkin's disease, if taken reasonably early and vigorously treated, was not necessarily fatal.

SURGERY OF THE THORAX, EXCLUDING DISEASES OF THE BREAST.

By GEORGE P. MÜLLER, M.D.

SURGERY OF THE HEART.

Gunshot Wounds. Operations for gunshot wounds of the heart are not new nor peculiar to this war. Several hundred successful cases have been published. But the unusual feature of the war surgery of the heart is the toleration which the heart has shown to the retention of foreign bodies. In many of the cases, operation was not done for months after the date of injury. It has also been surprising to note cases like that of Eccles¹ in which the man walked a mile and a half to the hospital at Ypres after he was wounded. Five months later, Eccles showed this man little the worse for the presence of a bullet in his right heart. In the war supplement to the *Index Medicus* will be found a nearly complete list of the cases up to the end of 1917. During that year appeared the interesting paper of Delorme and Delbet.²

Observation of the wounded gives the following clinical picture: The patient is dazed and syncopial, complains of retrosternal constriction, dyspnea on the slightest exertion, and mental anxiety; there is also arrhythmia and irregular amplitude of the cardiac pulsation. Later, however, the missile may be almost perfectly tolerated. Escande and Brocq³ have compiled 14 cases from the French literature. In 5, the tolerance is almost perfect. Dyspnea and precordial pain, at first severe, usually subside in time. I will present Delbet's case in detail and abstract a few others.

The soldier received a wound in the thorax from a hand grenade but recovered, with the symptoms given above persisting. X-ray showed the missile lodged in the heart. Operation was finally decided upon seventy days after the injury. The following is Delbet's description of the operation:

"I cut the flap with the base external, from the second to the fifth interspace, including about 6 cm. of the second interspace and about 10 cm. of the fifth interspace, the internal margin encroaching about 1 cm. on the left of the sternum. The costal cartilage and the internal costal muscles were cut. Lifting the margins of the incision and detaching them carefully with the gloved finger, with short strokes I separated the adhesion which firmly united the two pericardial layers. The sensation was exactly that experienced when breaking adhesions between an ovarian cyst and the intestine. The left heart was isolated first and

¹ Med. Press and Circular, 1915, xcix, 396.

² Bull. de l'Acad. de Med., 1917, lxxviii, 243.

³ Rev. de Chir., 1917, lii, 268.

then the right, under the supposition that the pericardium was forming a cover over the wound, and for fear of rupturing the wound by rough handling. The detachment was accomplished without difficulty. On exploring the pericardial cavity, a thick fringe was felt behind the heart, this was at first mistaken for the foreign body, but on exploring the heart the missile was easily palpated in the median right ventricle.

It was observed that as soon as the heart was freed of its pericardiac adhesions the beats at once became fuller and more regular. A small amount of blood, no doubt coming from the ruptured pericardiac adhesions continued to flow around the heart. I then, with the left hand, seized the heart a little below the auriculoventricular region, the fingers being behind the heart and the thumb in front of it. Then with the third and fourth fingers I turned back the heart into the palm of the hand against the thenar eminence and with the pulp of the flexed middle finger pushed the foreign body forward by pressing on it from behind; with the index finger placed in back and toward the left, the thumb in front and to the right, the right heart was folded by applying the surfaces of the fold against the foreign body. I then lifted the heart, turning it gently toward the left and made a clean incision of about 3 cm. on the right border. A few drops of dark blood escaped from the heart through the angles of the wound. With the middle finger the missile was pushed through the incision and was seized with Kocher forceps and removed, and the incision immediately closed by joining the margins. With a Chaput intestinal needle and catgut No. 2, non-perforating sutures were easily placed at three points. The heart was gradually released; there was no bleeding. Finally, I sutured the pericardium after wiping it dry with gauze, and followed with deep and superficial sutures of the flap. The operation lasted three-quarters of an hour. The missile was a cube-shaped irregular piece of steel about $1\frac{1}{2}$ cm. in periphery.

On the evening of the operation, the patient, entirely ignorant of what had been done, felt much relieved, and experienced only a slight retrosternal constriction. There was neither syncope, depression, nor cardiac arrhythmia. For three days the pulse rate was 140 and the temperature varied from 38.5° to 39.4° , due to slight pulmonary congestion with pleural effusion. On the twelfth day the condition of the patient was normal.

When seen again thirty-eight days after the operation, radioscopic and physical examination showed evidence of pericardopleural adhesions and functional disturbances consisting of tachycardia, unstable pulse, without arrhythmia, exaggerated oculocardiac reflex, diminished resistance."

Delorme groups the gunshot wounds of the heart into (1) those with the foreign body in the wall, operation easy; (2) those with the foreign body in the wall but protruding into the cavity, operation more complicated; (3) the foreign body in the cavity, auricle or ventricle, operation dangerous, particularly when the missile is in the left heart.

He remarks that even if the foreign body is irregular in shape, it may remain for some time without causing clot or injury of the endocardium or valvular defect. The heart undoubtedly suffers, and the

patient may be miserable, but Vouzelle is the only one to report a fatal termination of these retained missiles.

Diagnosis. The radioscope (fluoroscope) is of more importance than the radiograph (roentgenograph) on account of the rapid movements and oscillations of the foreign body. That these are important is evident from the statement of Delorme, that even if the foreign body moves synchronously with the heart-beat and is not influenced by respiratory movements, one cannot be sure that it is lodged in the heart itself or is adherent to it. (I can confirm this statement from a case seen in civil practice). He quotes from the roentgenologist, Lobligeois, the following typical description of the oscillations of a movable foreign body in the right ventricle: "At the end of diastole the ball rests on the lower border of the heart near the point. At the systole it moves from left to right following the lower margin and batting against the intraventricular septum, then following the latter from below upward in a vertical direction, until it reaches the highest point of the ventricle and against the right border of the heart. At the end of systole it rests immobile for a moment and then slowly descends from above downward and from right to left during the diastole, in order, at the end of the latter, to resume its position near the point of the heart and begin a new revolution. Thus the auricular movement is a twisted one (*en tourbillon*) and the ventricular movement is elongated and rapid."

There are as yet no data as to the typical oscillations of a foreign body in the left auricle and the left ventricle. But the swaying movement of the parietal ball extracted by Gaudier should be borne in mind in this connection.⁴

Indications for Operation. 1. A serious condition of the patient, persistent pain, violent palpitation and disturbed heart action. Operation is indicated whether or not the missile is penetrating, or in a parietal location, or in a cavity.

2. Slight benign symptoms. If the missile is located in the wall, the decision would rest on the usual indications for removal of foreign bodies lodged in an important organ. Intervention would be contraindicated, as in a case of Delbet's, in which the patient presented only slight tachycardia. A small foreign body may become encysted in the wall and remain there indefinitely without causing any more trouble than it would in any other location.

3. When the symptoms are not pronounced but the missile is located within the heart in an auricle or a ventricle, and is discovered accidentally as in the case observed by Lobligeois. In such a case he would not operate if the missile were in the left auricle on account of the risks of the operation; if it were regular and located in another cavity, a waiting policy would be indicated; if it were irregular, it should be removed.

Route of Access. After discussing the various means of approach as used by others, Delorme advocates his method (sometimes called the

⁴ Bond and Phillips (Jour. Royal Army Medical Corps, 1918, xxxi, 229) have described in great detail the cardiac movements of a bullet during systole and diastole and the translation movements during respiration and changes in bodily position.

Fontan flap), whereby an external hinged flap is made combined with excision of the left sternal border and large enough to expose the pericardial cavity not only to the eye, but also to the hand, of the operator. With a narrow opening, it is necessary to squeeze the heart with the fingers in order to draw it out, and, as Delbet remarks, with insufficient working room the sutures may tear out if the heart slips. The heart stands displacement well if it is not unduly traumatized, twisted or pulled forward too far. A large opening is also very convenient if profuse hemorrhage has to be arrested.

Costanini and Vigot⁵ report 2 successful cases, 1 operated on by means of a flap with its base situated externally and including the cartilages of the third, fourth and fifth ribs, followed by a transverse section of the sternum and permanent removal of part of its left border (Delorme); in the other, they made a chondrosternal flap including the entire corresponding segment of the sternum.

Delorme gives a few details about each of 17 cases collected from the French literature. Ten of these were removed from the right ventricle, 3 from the right auricle, 2 from the left ventricle and 1 from the left auricle. The results in 13 cases were surprising—10 recoveries and 3 deaths.

These do not represent all of the cases reported, nor those that will be. Thus, Le Fort⁶ alone states that he has removed 11 foreign bodies from the heart in the course of 9 operations—in 2 cases from the cavities. Only one patient succumbed; all the others were cured. I presented a number of these heart cases in *PROGRESSIVE MEDICINE*, March, 1917, and others will be found later in this article; some time we can collect them all and appraise the results.

HEART-BLOCK FROM HEART INJURY. Lea⁷ reports the case of a soldier wounded in the chest by a shell fragment on July 1, 1916. Five months later, when seen by Lea, he showed a typical heart-block after electrocardiographic examination. X-ray examination showed the fragment to be probably in the myocardium or in the substance of an adherent pericardium. It moved in an upward direction with the ventricle at each systole. Lea believes that a small hemorrhage implicated the auriculoventricular bundle and caused the trouble. The man was lost sight of, but it was not believed that the removal of the fragment would have cured the heart-block.

MIGRATION OF PROJECTILE. Among the curious and interesting conditions which the war has brought on, none is more unique than the migration of bullets or pieces of shell from the heart to the great vessels, or *vice versa*. One of the first to report such an occurrence was Grand Gerard.⁸ A soldier was wounded on October 10, 1916, and, one week later, a light local pain being the only symptom, an x-ray revealed a mass at the level of the right auricle which was subject to rapid and regular movements, having the character of an elliptical vortex. A

⁵ Rev. de Chir. Paris, 1917, liii, 383 and Presse méd., 1917.

⁶ Bull. de l'Acad. de méd., 1918, lxxx, 147.

⁷ Lancet, 1917, i, 493.

⁸ Paris méd., 1917, xix, 48.

little more than an hour later he was again placed under the screen, when no sign of the missile could be seen. A shadow was visible, however, at the level of the left Scarpa's space. On further examination a few minutes later, the shadow had again disappeared but it was readily found in the pelvis at the level of the sacro-iliac joint. Two days later, through a median abdominal incision, an attempt was made to locate and remove the bullet, but the operator was unable to reach it in safety. The bullet was located in the hypogastric vein and was fixed by ligating the vein (*en aval*).

A second case was reported by Gregory⁹ who observed the case of a soldier wounded in the chest on January 9. The bullet was located by the *x*-ray, and it moved obliquely upward and inward with respiration, and now and then oscillated quite violently through a distance of about an inch; the hemothorax was diagnosed and, on January 18, aspiration of the chest was followed by much trauma. Two days later the *x*-ray showed that the bullet had migrated into the abdomen and was an inch to the right and an inch below the umbilicus. On January 26, symptoms suggestive of appendicitis developed, and, as they persisted, operation was undertaken. The bullet was found behind the peritoneum, on the inner side of the ureter and presumably in the internal iliac vein. It was removed and the bleeding controlled, but patient died a few days later from peritonitis.

O'Neill¹⁰ reports the case of a man wounded in the chest, thigh and lumbar region. On admission, he was too ill for a thorough clinical examination of the chest, but it was found that the heart was not displaced and that there was well-marked pericardial friction. Three days later, *x*-ray showed a projectile moving synchronously with the heart beats. The movements were downward with the mediastinal respiratory movement, a lateral movement with systole to the right, and a flail-like movement with the base of the flail to the right side. One-half hour after returning to the ward the patient called attention to his left leg which was found to be blue in color and cold from above the knee to the foot. One hour later the leg appeared to be normal again. On the next day, *x*-ray showed the missile in the lower abdomen. Death occurred from gas gangrene. Autopsy showed the piece of shell at the bifurcation of the left common iliac artery surrounded by a dark red clot. The wound of entrance to the heart was on the posterior wall of the left ventricle.

These interesting cases are matched by the migration of the foreign body in the reverse direction. Probably the earliest case of migration to be recorded was that of Lyle¹¹ who reports the case of a Zouave wounded in thigh by a shell fragment. The *x*-ray of the thigh and lower abdomen was negative. The wound was laid open and methodically excised; the femoral vessels were found imbedded in a clot and the vein buried, but apparently intact. (Operation four hours after injury). Death occurred four days later from generalized gas bacillus infection. At autopsy, a rough shell fragment 1.5 x 0.9 x 0.5 cm. in size and

⁹ British Med. Jour., 1917, i, 482.

¹¹ Jour. Amer. Med. Assoc., 1917, lxviii, 539.

¹⁰ Ibid., ii, 719.

weighing 1.81 gm. was found free in the cavity of the right ventricle. There were fibers of clothing adherent to the irregular surface of the shell.

Specht¹² reports finding a shell fragment in the left ventricle at autopsy on a man who died of sepsis after a deep wound of the thigh. The foramen ovale was widely open thus affording passage to the fragment.

In the same journal, Jaffe adds a case in which a bullet entered the pelvis near the posterior spine of the ilium, entered the vena cava and was carried thence to the right ventricle, where it was found at autopsy lying beneath a flap of the tricuspid valve. The patient had complained during life of pain over the heart. Jaffe relates another case recorded by Freund and Caspersohn in which a shrapnel ball was removed from the lumen of the right ventricle. Although the wound of entry was situated at the edge of the right costal arch in the nipple line, no sign of wound in the heart wall nor effusion in the pericardium was found. The presumption, therefore, was that the ball had entered the vena cava and thence reached the ventricle, but, as the patient recovered, the point could not be proved.

Another case was reported by Ascoli.¹³ A soldier, while walking along a trench was struck in the back by a shrapnel ball. He did not lose consciousness but felt intense pain radiating to the left leg. This occurred on July 18, 1915. Five or six days later he was admitted to a hospital and an x-ray, on August 1, showed that there was a bullet in the iliac region. On September 1, a second examination showed no trace of the bullet, but finally it was found in the thoracic cavity over the cardiac area. The foreign body made rhythmical pendulum-like movements of about 2 to 3 cm., synchronizing with the contractions of the auricle. This movement was interrupted at intervals in the middle; at the internal limit of its course the projectile was caught up in a whirlpool which carried it back to its starting-point. The wound in the back ran a protracted course, healing was not complete until December. During this time the patient was free from symptoms and the heart was normal in configuration, size and position. It was not sure whether the bullet had entered the left iliac vein first or had penetrated directly into the vena cavity. In view of the fact that the man did perfectly well, operation was not attempted and no untoward incident occurred during the eleven months the man was under observation.

A few other cases will be found in the Italian and such German literature as is accessible.

As a corollary to Ascoli's case, Monti¹⁴ presents some experiments on dogs and on the dead body, concerning the migration of pellets of lead introduced into veins and the consequence of their passage into the heart. These experiments, however, were not particularly conclusive, except that they showed (what was easily proved clinically) that projectiles, when they have penetrated into the veins, may proceed in the direction of the heart with relative facility. No explanation is vouchsafed for the working of the bullet against the blood stream, but it is

¹² München. med. Wehnschr., 1917, i, 893; Edit. Lancet, 1917, ii, 395.

¹³ Malatte del Cuore, 1917, abstract in British Med. Jour., epitome, April 7, 1917.

¹⁴ Ibid.

probable that once displaced by position, the missile drops of its own weight down the vena cava.

CARDIAC ADHESIONS. Our knowledge of the removal of foreign bodies from the heart demonstrates that in certain cases the heart is entirely free in the cardiac cavity, when there has been no infection; frequently it is united to the pericardium by more or less extensive and often solid adhesions, usually easily separated but sometimes, as in Belot's and Laurent's cases, partial separation only was possible. Lefort found it entirely impossible to separate the adhesions in one of his cases.

The object of removing these adhesions is easily illustrated in Delbet's case, in which, after the adhesions were separated, the heart movements became stronger and more regular.

With regard to the return of adhesions, Delbet states that two months after operation radioscopic examination showed the renewal of adhesions. Dujarrier points out that forty-two days after operation, in one of his cases, there was a slight pericardial reaction. From these observations, we may infer that the future studies should be directed to ascertaining the causes of this development and the means of avoiding it.

Delorme suggests the following: The serous coats near the heart are the parietal and visceral pleura, which might be made to replace the modified pericardiac lining. The left pleura with its mediastinal fringes is dissected during operation; one could reach this in front of the partially excised pericardium. Dujarrier, no doubt fearing the extrapericardial adhesions, drew this pleura between the external surface of the pericardium and the wall of the heart on the median line and fixed the pleuromediastinal margin.

After suturing a wound in the heart, Leveuf, in order to avoid extrapericardial adhesions, insinuated a tongue of the left lung between the pericardium and the wall of the heart and fixed it with sutures. One could use a similar tongue and interpose it in front of an anterior pericardial opening. In fact, it is on the right heart, with its thinner wall, that these adhesions seem to exercise their greatest influence.

Adhesive Phrenopericarditis. F. Tremolieres and L. Caussade¹⁵ have encountered 20 cases of adhesion of the apex of the heart to the diaphragm, and establish it as a distinct nosological entity having special characteristic symptoms. Precordial oppression is complained of, generally coming on during rapid walking or running, though at times apparently induced by the process of digestion or even occurring during rest. There is more or less severe pain of the anginal type, occurring in paroxysms. Yet careful examination reveals no aortitis, arteriosclerosis, chronic nephritis, tabes, diabetes, nor high blood-pressure. Auscultation reveals only a rise in the heart rate, reduplication of the first sound or muffling of both sounds, but inspection and palpation will show absence of the apex beat. This, with the anginal pain, is the chief clinical symptom; the diagnosis is clinched, however, by x-ray examination, which shows that the left cardiodiaphragmatic sinus, normally clear and especially marked in deep inspiration, had disappeared, being

¹⁵ Presse méd., 1918, xxvi, 169, abstract in New York Med. Jour., July 6, 1918.

replaced by a triangular area of opacity, plainly circumscribed externally, with its base resting on the diaphragm and its summit merged with the cardiac apex, or oftener, with the lower part of the left ventricular margin. The anigmal attacks may recur only once a month or become more frequent, up to one every hour. In some cases the apex beat is perceptible almost as well as normally, but its site remains fixed and is not displaced during lateral inclination of the thorax. Exclusive limitation of adhesions to the apical region is suggested by absence of the other physical signs generally attributed to cardiac bands. Such patients constituted 2 per cent. in a series of 1000 heart cases. In 7 of the cases the original cause was tuberculosis or protracted bronchitis; in 6, rheumatic fever, and in 5, the eruptive fevers, especially scarlet fever, and in the other 2, possibly dysentery and malaria. Generally, the initial stage of the adhesive disease remains latent. Only rarely does it follow an acute diffuse pericarditis or a combined inflammation of the serous membranes. Symptoms appear at the longest in five years after the original pathological change.

HEART MASSAGE. A most interesting paper, with the report of a successful recovery after apparent death, has been published by Bost.¹⁶ It is reported that resuscitation of the heart's action occurred after twenty-five minutes' absolute cessation. The patient died seventy-seven hours later and it is remarked that the prolonged pause in the cerebral circulation was probably in part responsible for the onset of coma; had the kidneys and lungs been healthy, the patient might have recovered.

Bost remarks that heart massage is a complex performance. In its lightest rhythmical form it may undoubtedly stimulate the cardiac nerves, but a gentle squeeze of the organ does more; it empties the blood from the flaccid, perhaps distended auricles into the ventricles, the blood current acts as the physiological stimulus to these, and then the coronary arteries supply fresh blood to the cardiac muscles; thus a healthy circle is reëstablished, and is re-inforced by the artificial respiration, which should be carried on the whole time.

He condemns the "thoracic" route, and believes that the "sub-diaphragmatic abdominal" method is not very efficient as in the adult only the cardiac apex could be reached and this slips upward. He offers an improvement on the "transdiaphragmatic abdominal" route, as follows:

"The abdominal incision is made four inches long in the median line, extending from above the umbilicus well up into the xiphosternal notch. The left costal cartilages are well retracted, bringing the anterior diaphragmatic insertion well into view. There should be a pillow under the waist. A two-inch incision, beginning one inch to the left of the median line, carried outward behind the costal margin, cuts the fibers of the diaphragm near their insertion. A blunt instrument pushed in opens the pleural cavity, and the opening is rapidly dilated with two or three fingers of the right hand, so that the whole hand can then be

¹⁶ *Lancet*, 1918, ii, 552.

passed into the thoracic cavity anterior to the pericardium. The hand is passed upward, the thumb behind the sternum and the fingers embracing the entire organ in the pericardium. The thumb compresses the right auricle and ventricle, and the base of the heart is effectively massaged. No vessels are injured in this incision, as the superior epigastric artery is internal to the incision and passes into the rectus muscle, and the musculophrenic branch enters the diaphragm through the cellular tissue behind the eighth or ninth costal cartilages and passes backward, deeper than the incision. The liver and stomach, even if prominent, offer no obstruction to this route, nor is the pericardium in risk of being opened. During the massage, the parts can be pressed round the wrist of the operator so that air is not sucked in, and there is no tendency to collapse of the lung.

The incision is easily closed and made air-tight. The costal margin is retracted and the cut diaphragm pressed up while a continuous cat-gut suture is inserted by means of a strong, curved needle and holder. While this is being done, the assistant can make rhythmic pressure during inspiration, relaxed during expiration so that any contained air may be expelled and no more be allowed to enter. The abdominal wound is then closed in the usual way."

Bost then offers the following conclusions:

"1. The case reported illustrates that the human heart can be resuscitated after a variable length of time—in this instance after twenty-five minutes. Nothing else could have restarted the cardiac action in this case.

2. Type of cases for massage: All cases of suspended heart action following an anesthetic, regardless of theoretical etiological factors, after a certain interval. Cases of asphyxia should also fall within this group.

3. Length of interval: This should probably vary with individual cases, but should rarely be done under five minutes (unless the abdomen be already open), and certainly after eight minutes, though a longer interval need not bar the operation. The simpler methods of resuscitation, such as artificial respiration, tongue traction, sharp percussion over the cardiac region, and inversion of the patient, should begin in the first minute, but not be uselessly persevered in to the neglect of more efficient measures.

4. Subdiaphragmatic massage may suffice, especially in children, if very promptly undertaken. But if only the apex is reached and the heart remains unresponsive, the diaphragm should be incised and the base of the heart be massaged without further delay.

5. That no surgeon, even if relatively unskilled, should be content to abandon a case without giving his patient the benefit of direct cardiac massage.

6. We claim that this new technic offers a simpler method of approach and is a decided improvement upon all other ways of doing direct heart massage, as it involves less risk of hemorrhage, trauma and shock, and can subsequently be more quickly and satisfactorily closed."

Molyneux¹⁷ reports 2 cases with sudden collapse and cessation of the heart during operation. The hand was introduced into the abdominal incision and made to compress the heart through the diaphragm against the chest wall and was reinforced by pressure on the outside of the chest by the left hand. In both cases, after a short time, the heart recommenced to beat and the patient recovered.

Robertson¹⁸ reports another case of recovery after heart massage. The patient was about to be operated on for abscess of the thumb when the collapse occurred. The man seemed quite dead but Robertson "quickly put iodine on the skin, opened the abdomen and began heart massage." The patient recovered. The "man had been dead for at least three minutes, probably five." He refers to two other cases, one recovering and the other, a child of nine, succumbing.

Written as a commentary upon the case of Robertson above related, the following remarks are of interest:¹⁹

"Although the recorded history of this case makes no mention of the general nature of the general anesthetic, the history of the case suggests chloroform. The collapse of the patient would then be attributed to vagal inhibition of the heart, consequent upon stimulation of the cardio-inhibitory center in the medulla oblongata. Even if the collapse of the patient was due to syncope, a similar condition of the heart would be produced, the vagal stimulation being reflex in origin. In this condition the heart becomes acutely dilated with blood. If the heart-beat be inhibited through vagal stimulation, sooner or later the heart commences to contract again. Simple vagal inhibition will not permanently arrest the circulation. If, however, the cardiac muscle cells are partially poisoned with chloroform or injured in some other way, the heart may not be able to escape from the inhibition. When the heart is emptied by forcing its contents into the great arteries, the beats of the heart will restart and the circulation of the blood will be restored.

While various mechanical conditions connected with the circulation readily lead to failure of the heart-beat and of the circulation, the heart muscle is possessed of great vitality. The nutrition of the cardiac muscle and the irritability of the muscle cells depend upon the supply of blood to the heart. This supply, which is derived from the coronary arteries taking origin from the beginning of the aorta, is regulated by the blood-pressure in the arterial system. With a falling blood-pressure, less blood passes to the heart. In consequence of this diminution, the cardiac muscle fibers show lessened contractility and irritability. As far as is known, the heart-beat depends on the rhythmic contractions of the muscle cells, which are initiated by chemical changes, regulated by the blood supply and by mechanical stimulation, such as tension of the heart wall. When the heart is excised from the body, its beat can be restored by connecting the root of the aorta with a raised funnel containing warm blood, which has been well oxygenated. By somewhat similar procedures the hearts of children removed on the postmortem

¹⁷ British Med. Jour., 1917, i, 420.

¹⁸ New Zealand Med. Jour., 1918, xvii, 142.

¹⁹ Editorial in Med. Jour. of Australia, 1918, ii, 249.

table have been resuscitated several hours after systemic death. It is thus not surprising to find the heart commencing its movements upon compression after a pause of a few minutes."

In a letter to the *British Medical Journal*, April 14, 1917, p. 497, Kidd calls attention to the method of Argaud²⁰ which he thinks is more logical than the usual bimanual method. The region of the right auricle and its intrinsic ganglia (tenia of His, node of Keith-Flack, valve of Thebesius) should be lightly tapped with the finger-tips at intervals of not less than ten or more than thirty seconds. He suggests that the method is worthy of trial in those cases where the surgeon does not want to open the abdomen but he does not note whether the chest should be opened or whether external "tappings" would suffice.

THE LUNGS AND PLEURÆ.

Last year brought out little that was new in the war surgery of the chest. More attention was paid to the perfection of technic, and to a consideration of the best way of emptying the chest of its contained infected blood clot than to new theories. The controversy between those who advocate a radical operation at the front and those who favor a more conservative policy has simmered down. Likewise the matter of the late removal of foreign bodies has become nationalized to a large extent, the French usually favoring removal, and the English the "let alone" policy.

In the translation of Duval's book on *War Wounds of the Lung* there is an addendum dated January, 1918. Further remarks by Duval are quoted in *War Medicine*²¹ in the report of the Seventh Session of the Research Society of the American Red Cross in France. From these sources his position regarding early operation is brought up to date.

Duval found, from a series of collected records, that of 3453 cases treated medically with *surgical treatment of the complications only*, there was a mortality of 30 per cent.; infection occurred in 25 per cent., with a mortality in these infections of 40 per cent. After he had embarked upon early surgical treatment, he found that during 1917 he had had control of 161 cases in one sector. This included all cases from the field ambulance to the evacuation hospital, all the cases who died without having been operated on, those operated on for serious bleeding or opened thorax, those operated systematically and those not operated on.

There were 27 deaths (16.7 per cent.), but, of these, 13 were in such bad condition when they reached the ambulance that nothing could be done to save them.

Of 148 cases which were in shape for treatment, 29 were in urgent need of operation, either because of hemorrhage, 16 cases, or open thorax, 13 cases—13 of these, or 44 per cent. died. Seventeen additional cases were operated on without indications of urgency but for removal of large fragments, intrapulmonary missiles, fracture of ribs or scapula, or the treatment of the lung injury so as to avoid pleuropulmonary infection.

²⁰ Compt. rend. de l'Acad. Sc., 1913, clvi, 1787.

²¹ War Medicine, 1918, ii, 1.

This operation consisted of (a) removal of the foreign body, (b) direct treatment of the wound of the lung, (c) control of bleeding in the pleural cavity and evacuation of clot, (d) careful excision of the wound of the chest walls. Of the 17 operations, 12 healed and 5 developed infection, cured by a secondary operation. Duval was of the opinion that these infections were due to the fact that the wound of the lung had not been thoroughly treated, incomplete excision, bits of clothing or splinters or missiles remaining in the wound or pleura.

The technic of Duval was described in these columns in 1917, and again in 1918. He states that it has been materially improved.

In one case he laid open a through-and-through wound of the lung, excised, and sutured it; the patient recovered. In another case he mopped out the track with gauze; this patient also recovered. In superficial wounds, excision with curved scissors before suture was always carried out. In one case the wound was excised, curetted, and cleaned with ether; recovery was uneventful except for a small sterile pleural effusion. In this case the wound contained a missile and splinters of bone, which gave cultures of bacillus perfringens and staphylococcus. In 2 cases he resected a third of the injured lobe and afterward sutured the lung; both cases recovered. In one of them the missile was in the pericardium, whence it was removed, the pericardium being incised and sutured; 102 cases were not operated on, there being no indication for so doing; 5 developed empyema and 1 died from the infection.

Duval compares his mortality of 16.7 per cent.; his percentage of infection of 15 per cent. and the mortality of these 20 per cent., against those quoted above—apart from the urgent cases, 119 cases were treated, with only one death.

At the second and third Interallied Surgical Conferences, the chest wounds were considered and the following conclusions adopted:

SECOND CONFERENCE: 1. Wounds penetrating the chest result in a mortality estimated at 20 per cent. in the sanitary formations of the Army zone.

2. Early death is the rule because of asphyxiation and hemorrhage. Shock plays a large part in the early or immediate death.

3. Late mortality usually results from pleuropulmonary infection.

4. Pathological anatomy established that the pulmonary lesions are the same as those of all war wounds. The mechanical disturbances are the same, the infection is the same, except that pulmonary tissue resists infection better than other tissues, but the infection of the pleura, either by the external air or by the pulmonary wound, may seriously complicate the case.

5. Two points in the treatment are of utmost importance: Immediate attention, and complete immobilization of the patient.

When the patient is suffering from shock, general treatment for shock should be undertaken, and the patient should be given a reclining posture, with the head lowered.

Medical treatment is sufficient for the healing of many chest sounds which present no complication.

Surgical treatment should be employed for parietal lesions and for immediate or late complications.

In all cases complete surgical treatment of thoracic lesions (wounds of the soft parts, fractures of the ribs, etc.), is absolutely necessary, as in all war wounds.

A. IMMEDIATE COMPLICATIONS. (a) *Opening of the Thorax*. Closing is necessary either by plugging or by direct suture of the wall.

(b) *Hemorrhage*. With open thorax: Direct hemostasis of the lung either by plugging or by hemostatic suture. With closed thorax: If it is certain that shock is not the primary cause, and if the blood-pressure drops in spite of treatment, and if there are symptoms due only to hemorrhage, the ideal operation is thoracotomy with direct hemostasis of the lung. Indication for operation in cases of closed thorax is very rare. Such treatment requires competence and equipment of the highest order.

(c) *Hemothorax*. If hemothorax is discovered, puncture to relieve mechanical compression is permissible. It is well during or after the drawing of the blood to inject air or oxygen into the pleura, in order to prevent hemostatic collapse of the lung. Febrile hemothorax calls for exploration by repeated punctures for the bacteriological examination of the liquid.

B. LATE COMPLICATIONS. (a) *Persistent Aseptic Hemothorax*. This variety of hemothorax should be treated by repeated puncture for evacuation, to allow of pulmonary expansion. The introduction of a certain amount of oxygen into the pleura during or after these punctures is often useful.

(b) *Infected Hemothorax*. When infection of the pleural fluid has been established by bacteriological examinations thoracotomy is definitely indicated.

(c) *Purulent Pleurisy*. This may be treated in the same way as infected hemothorax. When drainage is deemed necessary it should always be effected at the lowest point (the posterior base of the thorax).

6. Treatment of pleural suppuration by the method of progressive sterilization.

In recent or old cases of pleural suppuration there may be practised progressive sterilization and secondary suture of the thoracic wall. There is no reason to fear a suture of the thoracic wall over an empty cavity. It is the best treatment to obtain rapid expansion of the lung and the disappearance of the pleural cavity. (Depage.)

7. In urgent cases it is well to proceed at once to the extraction of intrapulmonary projectiles when conditions are favorable.

8. Whatever the circumstances, prophylactic therapeutics of the pleuropulmonary infection by means of direct surgical treatment of the lung wound (extraction of all foreign bodies, suture of the wound with or without excision) seems the logical procedure. This question deserves careful investigation.

9. Blood effusion in the pericardium is governed by the same therapeutic principles as hemothorax.

THIRD CONFERENCE: Surgical treatment of chest wounds tends clearly toward active surgery:

(a) In case of dangerous hemorrhage, an open thorax is always operated.

(b) Primary extraction of intrapulmonary projectiles is more frequently practised.

Treatment of the parietal wound consists in excision and removal of all foreign matter, whether bone or metal, lodged in the lung, cleansing of the wound, and immediate primary closing of the thorax. Good results thus obtained clearly justify this method of surgery.

(c) Infected hemothorax is treated by very early drainage and progressive disinfection and secondary closing of the thorax.

(d) Chronic purulent pleurisy is amenable to progressive sterilization, accompanied, if necessary, by the opening of the pleuropulmonary casing by several incisions.

Some of the points considered and coded in the Conference will be found described in detail in an excellent paper by Lockwood and Nixon.²² I will quote a large part of their article *verbatim*:

"The surgical measures which these cases appear to justify should not be attempted unless:

(a) Active resuscitation can be carried out immediately after admission.

(b) The services of an expert radiographer are at all times available.

(c) The physical signs can be carefully studied and judiciously interpreted.

(d) The most perfect asepsis can be secured at the operation.

Given these conditions, we are guided by the following general rules for operation:

1. Operate as soon as the patient's condition allows. (This is much earlier with local than with general anesthesia.)

2. Operate at a place where early evacuation will not be necessary.

3. Operate in all cases where *injury of the diaphragm is suspected*.

4. Operate on all cases with open pneumothorax (traumatopnoea).

5. Operate on all badly 'stove-in' chests, where the pleura is lacerated, even though there is no external wound.

6. Operate on all cases where a large missile has traversed the pleural cavity, whether lodged in

(a) The chest wall,

(b) The pleural cavity,

(c) The lung,

(d) The mediastinum, or

(e) The pericardium.

7. Operate on all very acutely infected cases, even although the missile is not retained."

"In no other branch of war surgery is the technic of the operation more exacting, although the manipulations themselves do not require any exceptional dexterity.

"A separate theatre is reserved for chest and abdominal operations and a uniform temperature of 80° is maintained. We have found it possible under all conditions, and we believe it is always possible, to maintain as perfect asepsis in a casualty clearing station as in civil

²² British Med. Journal, 1918, i, pp. 105, 145.

hospitals. Cap, mask, gloves, and gown are worn by operator, sister, and assistant, and changed between each case. No one is allowed in the theatre unless wearing a sterile gown, and patients are brought into the theatre in blankets and pyjamas which have been put through the Thresh disinfectant the night before. The patient has been given omnopon-scopolamine (one ampoule) an hour before operation, and, if not sleeping, is given one-half ampoule half an hour before being taken to the theatre.

"For operation the patient should be maintained with the injured side dependent. In the majority of cases the half-sitting posture is the most comfortable. A simple apparatus has been devised which allows free access to the injured side and which can be applied to any table.

"If the patient cannot be placed with the injured side of the chest dependent, the lung should be grasped with forceps of the Collin pattern immediately on opening the thorax, and sufficient traction exerted to correct displacement of the mediastinum. (Murphy.)

"The skin is prepared with picric acid (3 per cent.) in spirit; paravertebral anesthesia is administered for two or three spaces above and below the wound, depending on the extent of the wound and the incision contemplated. To avoid delay, a local infiltration around, but at some distance from, the wound is employed. Novocain 0.5 per cent., potassium sulphate 0.25 per cent., in normal saline, prepared fresh and repeatedly autoclaved, is injected with a Gray's syringe (10 minims of adrenalin per ounce are added just before use). Gas and oxygen should be available to be administered while the hand is inside the chest or if the patient is restless; in the latter event a light nitrous oxide analgesia only is maintained.

"The most serious chest cases can be operated upon with this type of anesthesia—cases which would never be fit for a general anesthetic, such as ether or chloroform. A more extensive, deliberate, and protracted operation can be undertaken with the minimum of shock to the patient under local anesthesia combined with gas and oxygen. Respirations are deeper and more regular than with ether or chloroform, and the movements of the lung, mediastinum and diaphragm can be voluntarily controlled by the patient to some extent. The two-stage operation, which will be described later, is possible only with this type of anesthesia. Postoperative restlessness, vomiting, retching, and coughing never occur, and this plays no small part in the success of the operation, especially in a busy unit where an attendant cannot always be at the bedside.

"Never should ether or chloroform be used in chest surgery. The manipulative technic of chest surgery is extremely simple, but the utmost speed is essential. There is no doubt that unless primary union is obtained the patient's condition is made grievously worse by operation. Primary union will not result without bold and thorough excision of the wound area. After the track of the missile through the chest wall has been excised, the gloves of the operator are changed, the instruments used are discarded, the skin is again thoroughly cleansed with picric acid, and fresh towels are used. Rubber dam, if available, or towels are draped about the incision, in such a way as to expose no skin and the

minimum of muscle, and fixed with clips. The patient and table should be entirely covered with sterile towels or an operating sheet.

"When the position of the wound will permit, resection of the fourth rib from the midclavicular to the posterior axillary line furnishes the easiest access to the thoracic cavity. Resection of the rib must be wide enough to allow careful inspection of the cavity. Doyen's periosteal elevator and costotome are the instruments we have found best for resection of the rib. Tuffier's retractor is most satisfactory for obtaining a sufficiently wide opening. It is important, however, not to exert too powerful retraction on the chest wall, as the tendency to shock is thereby increased and the mediastinum unduly disturbed.

"Immediately after opening the chest, rapidly mop out the thoracic cavity with gauze wrung out of hot saline carried on a long curved forceps of the Ochsner pattern. Unless there is fresh hemorrhage within the chest—which, of course, must always be attended to first—lacerations of the diaphragm must be first dealt with. Where access to the abdominal cavity through the chest is necessary the diaphragm may be freely incised without hesitation.

"No wound of the diaphragm should be left unrepaired whether on the right or left side. Particularly when the missile has tracked through the diaphragm and lodged in the liver, the track through the diaphragm must be excised and the diaphragm incised widely enough to expose completely the track in the liver, and the missile removed. The track in the liver should be thoroughly cleansed out with a Volkmann's spoon, followed by swabs wrung dry out of saline and ether.

"If oozing occurs, deep catgut sutures should be inserted with a blunt needle. As we have pointed out in an earlier paper on 'Abdomens,' missiles should not be left in the liver. A complete and thorough toilet of the track is always necessary; hemorrhage is not to be feared. The very low resistance of the hepatic tissues to infection makes it important to remove all sources of infection. Having dealt with the liver, close the diaphragm with mattress sutures of catgut on a blunt needle, except where the diaphragm is stripped from its parietal attachment. We do not believe it is advisable, or ever necessary, to suture the diaphragm to the chest wall (as suggested by Depage.)

"If the missile has passed through the diaphragm into the abdomen and an injury of a hollow abdominal viscus is suspected, it is wiser to deal with the abdomen after having closed the chest. After repair of the diaphragm, the lung, held with the Collin forceps, should be brought up to the opening in the chest (pneumopexy prolongs the operation and is never necessary), remove the missile or fragment of rib (if lodged in the lung), excise, thoroughly clean and suture the track or lacerations with mattress sutures of catgut, which should not be so tightly tied as to tear out an expansion. For repair of lung tissue a blunt round-bodied needle is used.

"Partial lobectomy may be necessary, depending on the degree of laceration of the lung. Total lobectomy and, in one case, excision of both middle and lower lobes of the right lung has been necessary for acute malignant gas gangrene, but has not saved the patient's life. We

have been struck by the rarity of finding an open bronchus at operation. For such a condition crushing and ligaturing with catgut is sufficient. It is essential that the visceral surface of the lung should in all cases be approximated, thus mechanically retarding effusion from damaged lung, and lessening the tendency for infective conditions to light up in the lung substance itself. Hemorrhage from the lung need not be feared.

"All blood clot, pieces of cloth, fragments of bone, etc., must be carefully hunted for and removed from the thoracic cavity. The toilet of the pleura can better be performed by sponging (as in the case of the peritoneum) than by washing out. The last step before closing off the pleural cavity is to sweep round the chest wall, lung, mediastinum, and diaphragm systematically with swabs wrung dry out of hot saline, and, finally, with a swab wrung dry out of warmed ether.

"The chest should always be closed, unless there is extensive gas gangrene of the lung tissue itself adherent to the chest wall.

"Time should not be wasted in attempting to repair the parietal pleura in extensive wounds, as it can rarely be done; such pleura as remains can be caught up with the muscle sutures.

"The chest must be hermetically closed with the first layer of muscles, otherwise pocketing will occur, pleural effusion accumulate, the incision break down, and the operation fail. From the time the pleura is opened until it is closed, when the hands of the operator are not actually in the chest, the hole in the pleura should be covered by thick lint wrung dry out of hot saline. This closure is important, even if only for a moment at a time.

"Careful approximation of the skin edges is necessary to ensure early and absolute primary union.

"At one time we concluded the operation by aspirating the air from the pleural cavity with a Record syringe. From what we have seen of early postoperative expansion of the lung this step is unnecessary.

"In some few cases we have left sodium bicarbonate solution in the chest (Witzel's method) and withdrawn it after eighteen hours. We have seen no benefit from its use either in providing an alkaline field to inhibit bacterial growth or in aiding expansion of the lung. A wide gauze dressing with mastisol or 'aeroplane dope' reduces the tension on the sutures and binds the layers of the chest wall so as to prevent oozing and pocketing. A binder made of 7-inch adhesive plaster (tying over the dressing) is valuable to retain the dressing, as well as to relax tension on the sutures and leave the sound side of the chest free for expansion; the latter is extremely important.

"On completion of the operation the patient should at once be supported in a semi-recumbent position inclined to the injured side.

"Certain details of the operative procedure described above are gone into more minutely by Blair and Shattuck,²³ particularly in regard to the subscapular and diaphragmatic lesions.

"Frequently there is much damage to the chest wall, deep under the scapula, and trephining of the scapula is most unsatisfactory. The best

²³ Jour. Royal Army Medical Corps, 1918, xxxi, 177.

method is to displace the scapula from the vertebral border by dividing the rhomboids and serratus magnus with an incision extending the full length of the scapula. It may be necessary to ligate the posterior scapular artery, and to divide the slip of the latissimus dorsi inserted into the angle of the scapula. The scapula can then be moved upward and outward, so as to give access to the chest wall beneath it. The muscles can be sutured afterward, and little interference with scapular functions ultimately results.

"The diaphragm can be easily reached by making an incision along the line of the sixth rib from the mid-axillary line, as far as the costochondral junction. The costal cartilage is divided at least one-half inch internal (nearer the mid-line) to the costochondral junction, care being taken not to injure the subjacent pleura. By dividing the intercostal muscle along the lower border of the rib, and then making traction on the sixth rib upward with a retractor, the intercostal space can be enlarged. Then, after dividing the pleura along the middle of this space, and introducing a retractor of the Tuffier type, one finds easy access to any part of the diaphragm. Through the diaphragm one can reach the track of a missile in the liver. The diaphragm can be readily sutured with catgut, by means of a curved needle and needle-holder. The chest should be closed with a muscle-pleural suture of catgut, and the costal cartilage repaired by one or two sutures of strong gut. The advantage of this operation lies in the fact that the chest wall is replaced in its entirety, and that the postoperative distress which follows rib resection is conspicuously absent."

Abdominothoracic Wounds. When the thorax and abdomen are both invaded, certain special details seem to arise. The third Interallied Conference had this to say:

"In wounds of the abdomen and thorax, the wound of the diaphragm constitutes the specific factor of the lesion; the wounds of the organs of the abdomen and thorax present no special anatomical interest.

Hernia of the abdominal organs is difficult to recognize clinically. Radioscopic examination reveals the displacement of the heart to the right, and so helps in diagnosis, so far as the left side is concerned.

Indications for operation are absolute except in the case of a very small projectile in the upper part of the abdomen, especially at the right. The perforation of the diaphragm in itself necessitates suture.

Approach by way of the pleura affords especial advantage for exploration of the lesions and also for treating the pleural cavity or for suturing the diaphragm. It permits also the treatment of lesions in the abdominal organs, beneath the diaphragm, whether there is hernia or not.

A separate laparotomy may sometimes be necessary.

The opening of the thorax and abdomen by a single incision permits generous treatment of both chest and abdominal lesions."

Influence of the Missile. Last year I quoted from DePage and Jaussen and from Gask to show the effect of different missiles in chest injuries. Hutchinson²⁴ has had the following experience in 450 cases:

²⁴ Canadian Med. Assn. Jour., 1918, viii, 972.

"The wounds of the chest, which came under my care, were produced by three types of missiles, *viz.*: bullets, shrapnel balls, and pieces of shell. In my series of 450 cases, 127 were produced by bullets, 50 by shrapnel balls, and 273 by pieces of shell. These various missiles differ both in their immediate and late effect, some of them producing more serious complications than others. Wounds produced by bullets were the least serious, those produced by pieces of shell the most serious, while those produced by shrapnel balls took an intermediate place.

"The difference in the effects produced by these three missiles may be attributed to three causes:

1. The bullet, having a tremendous penetrating power, produced small entrance and exit wounds and tended to pass directly through the chest, only a few remaining in the lung. The heat of the bullet caused a certain amount of cauterization of the track and they did not, as a rule, carry in with them any foreign matter.

2. Pieces of shell, on the other hand, tended to leave the chest open, to injure intercostal vessels; to produce large lacerations of the lung; to remain in the lung and to carry in with them all kinds of foreign material.

3. Shrapnel balls, on account of their size and shape, tended to injure the bony framework of the chest, and remain in the lung, and, because of their round, smooth surface, only occasionally carried in with them any foreign material."

A glance at the following tables will give an idea of the penetrating powers of the different projectiles and their tendency to produce infection of the hemothorax.

Shell.		Bullet.		Shrapnel ball.		Total.
Retained.	Not retained.	Retained.	Not retained.	Retained.	Not retained.	
164	109	18	100	22	28	450
36.4%	24.2%	4%	24.2%	48%	6.2%	

INFECTED.

Shell.		Bullet.		Shrapnel ball.		Total.
Retained.	Not retained.	Retained.	Not retained.	Retained.	Not retained.	
37	18	4	13	6	3	81
45.6%	22.2%	4.9%	16.04%	7.4%	3.7%	

Infected Hemothorax. There is but little to add to what was thoroughly gone over last year. Interesting papers have appeared, particularly those of Dean,²⁵ Fortescue-Brickdale,²⁶ Crymble,²⁷ and others. Hutchinson,²⁸ impressed by the results obtained by the open treatment of knee-joint injuries with primary closure, decided to apply the same principle to the treatment of the infected hemothorax.

The method he evolved is as follows: As soon as a hemothorax is found to be infected—both clinically and bacteriologically (not merely

²⁵ Quarterly Jour. of Med., 1918, xi, 59.

²⁷ British Jour. of Surg., 1918, v, 363.

²⁶ Ibid., p. 267.

²⁸ British Med. Jour., 1918, i, 196.

bacteriologically)—the patient is taken to the operating room and nitrous oxide-oxygen administered. A portion of rib, long enough to allow the hand to pass through the opening, should be removed and the blood allowed to flow out. The clot is then removed by the hand, all parts of the cavity explored, and light adhesions broken down. Then, by means of large pieces of gauze on dressing forceps, the remainder of the blood and clot is removed. After this, the cavity should be washed out with saline and again mopped out, and a running suture inserted in such a way as to include the pleura and intercostal muscles. This suture should be left quite loose, so that a small quantity of some antiseptic can be poured into the pleural cavity. This antiseptic should be spread all over the walls of the cavity by means of a small piece of gauze on long dressing forceps. As soon as this has been done, the running suture is drawn tight, thus closing the pleural cavity completely. The muscles and skin are then closed, and a dry dressing applied.

Forty-eight hours after the operation, the chest should be aspirated, thus removing a quantity of serum and air. This is done for two reasons: (1) The serum by that time has lost its bactericidal properties, and then only becomes a menace; and (2) by removing a good deal of the air from the pleural cavity a negative pressure is obtained which helps to re-expand the lung. It will be found that three or four aspirations are necessary during the course of convalescence.

The antiseptics which Hutchinson has used in these cases include eusol solution, 1 in 2; a suspension of bipp in liquid paraffin in the following proportions, bipp $\frac{1}{2}$ ounce, liquid paraffin 6 ounces; flavine solution 1 in 5000, and normal saline, the amount left in the chest being 3 ounces.

Only 29 cases were treated in this way, and 13 had to be reopened and drained. The results with "bipp" were best; infection from *Bacillus aerogenes capsulatus* generally resulted favorably, but 6 of the 7 streptococcic infections had to be reopened.

If these cases must be drained because of the onset of infection, or if the operator finds it necessary to drain at the first operation, I believe that the method of Campbell²⁹ is worthy of trial. He has found that it makes it comparatively easy to raise the pleural cavity to "suture standard" and to effect secondary closure at an early date.

Campbell fills the pleural cavity with Dakin's solution every four hours and siphons it off two hours later. He prefers the rib resection as far forward and as low as possible—that is, usually the eighth rib in the mid-, or anterior axillary, line. He resects three and a half inches of rib, explores the cavity, cleans it out, and drains with a one-quarter inch rubber tube so placed that its fenestrated end lies in the costovertebral recess behind the pericardium. The wound is loosely sewed up, no attempt being made to effect an air-tight closure round the tube.

"When the patient has recovered from the operation, the size of the cavity is estimated by filling it carefully (but usually incompletely)

²⁹ British Med. Jour., 1918, i, 109.

with warmed Dakin's solution, and then emptying it. After this, the cavity is filled through the tube every four hours to about one-third of its capacity, or less, with Dakin's solution. At the end of two hours another long tube is attached to the tube in the chest and the fluid siphoned out, the patient meanwhile lying on the sound side with the chest opening uppermost, or as nearly so as possible. The patient is told to pant or cough slightly at frequent intervals as long as the fluid remains in the chest, and by this means splash the fluid about inside the cavity, and so bathe with it the entire infected surface and any recesses that may exist.

"In this way the pleural cavity contains for two hours a large quantity of sodium hypochlorite solution and is more or less empty for a similar time. During the former period the patient lies rigidly on the sound side, without any raising of the shoulders, to prevent escape of the fluid and consequent flooding of the bed; during the latter, he is free to lie as he chooses. Thus the patient gets a reasonable amount of rest and comfort and is saved the exhaustion associated with the maintenance of one constant position. In addition, once daily, the tube is removed, sterilized, and replaced, and the cavity washed out as in the usual treatment for empyema. To overcome the disadvantage of injecting cold fluid into the chest, he has found that it is better to make the Dakin's solution of double strength and, prior to filling, to dilute it with an equal quantity of warm, sterile water.

"If the original wound and site of fracture lie sufficiently far forward, advantage is taken of this site for the insertion of the tube.

"Sometimes difficulty is met with in siphoning out the fluid; this may be due either to the tube that is connected to the tube in the chest not being first filled with liquid or else to air being unable to enter the pleural cavity; in the latter case, it is well to slip an open-ended Carrel tube into the chest alongside the first. When this is done, he uses the smaller tube for filling up the pleura, as then the liquid cannot be injected too quickly.

"When treatment is carried out in this way, it is found that pus formation and offensive odor largely disappear at the end of thirty-six hours and are absent at the end of three to four days; the patient's tongue becomes clean and moist almost at once; delirium and emaciation, so frequently seen in these cases, are absent, and the temperature and pulse-rates fall much more rapidly than usual; indeed, when looking at them, it is hard to distinguish these cases from those that are not infected.

"If pus continues to form under this method of treatment, it appears to be due to one or more of the following causes:

1. The Dakin solution is not of proper strength or is used in insufficient quantity.

2. The cavity is not regularly filled and emptied.

3. A loculated cavity exists which the fluid does not reach.

4. A foreign body or loose bone fragments still remain in the pleural cavity.

5. Sloughing or abscess formation is taking place in the lung substance."

Dobson³⁰ believes that this method as well as that of Tuffier (irrigation through Carrel tubes) is difficult and tedious and prefers to insert a silver cannula above for irrigation. He has described this cannula previously³¹ as consisting of a curved silver tube with no terminal aperture. It is perforated with twelve small tubes and fitted with a blunt end trocar. A shield is perforated with holes for suture.

The cannula is used in the following way: After opening the chest, a point on the chest wall toward the upper limit of the cavity is selected where the cannula may most conveniently be introduced. This is usually in the third or fourth space, about or just external to the mammary line; a small incision is made through the skin, and the cannula pushed through the intercostal muscles into the chest. The tip of the cannula should point outward and downward, and the instrument fixed in position by two sutures to the skin. The original incision is then closely sutured around a drainage tube, which may be long enough to reach into a bottle of antiseptic fluid. The tube of a Carrel ampoule is then attached to the cannula, and the cavity irrigated every two hours. Hitherto, I have generally used eusol, but no doubt other solutions will be as efficacious. If the cannula is judiciously placed (and in large cavities more than one can be inserted) the whole of the pleural cavity is easily exposed to the action of the antiseptic. When the thoracotomy wound is closely sutured around the drainage tube, no dressings are required for several days. The tube passes out through the dressings into a bottle, and the cavity is washed out every two hours without any disturbance of the patient. The best method of fixing the drainage tube and occluding the wound around it is to pass two catgut sutures, one on either side, through the muscles and through the wall of the tube supported by two silkworm gut stitches through the skin, also picking up the drainage tube. There is then no leakage around the tube, the dressings remain dry, and can be left undisturbed.

In most cases it becomes necessary to remove the silver cannula before the cavity is completely closed. The rapidly expanding lung presses the point of the cannula against the chest wall and causes some pain. It is as well to continue the progressive sterilization of the cavity after the cannula has been removed, by inserting an ordinary Carrel tube through the drainage wound for the instillation of the chosen antiseptic. This is continued until the lung is completely expanded.

Treatment of Retained Projectiles. There is more divergence of opinion regarding this phase of chest surgery than about any other. The English surgeons generally incline toward a conservative policy. Thus Fortescue-Brickdale³² states, "It seems very doubtful if any real advantage is gained by extensive operations on the lung for the removal of bullets or shrapnel fragments, unless there is a definite evidence that they are septic, and producing abscess or gangrene of the lung. Where there are no signs of this, the foreign body is probably harmless." Hutchinson,³³ as the result of an experience of 450 cases, concludes

³⁰ British Med. Jour., 1918, i, 662.

³² Quarterly Jour. of Med., 1918, xi, 267.

³³ Canadian Med. Assn. Jour., 1918, viii, 972.

³¹ Ibid., i, 148.

that "no attempt should be made to remove the foreign body from the lung while the patient is in a Base Hospital in France." He refers to the figures of Rudolph and of Elliott as confirming this stand. I abstracted these papers last year.

The French usually operate, not only because of the fear of infection and abscess, or recurring hemoptysis, but even for fear of nervous disturbances. Sergeant³⁴ and others report a number of such cases in which the men complained of pains, unstable pulse and respiration rhythm, with constant dyspnea, exaggerated at the slightest movement. Some had neuralgia of the phrenic nerve or partial paralysis of the diaphragm; in others the pupils were irregular and unstable or there were vasomotor disturbances. Five of the ten men presented, besides, signs of exophthalmic goiter. If the projectile is no longer in the tissues, these functional disturbances usually gradually subside.

The following interesting discussion is taken from Barjon:³⁵

"The mode of procedure in penetrating wounds of the thorax is highly interesting to the radiologist, because, in discussing the question of indications and contraindications for operation, aside from clinical facts, medical and surgical, an important place ought to be given to radiological findings.

It is necessary, therefore, that the radiologist be in a position to appreciate exactly the value of the information obtained from his examination.

There are three groups of facts:

(a) *Positive and Urgent Indication.* The first group includes febrile infected patients with the appearance of being seriously ill. Radioscopic examination shows that the center of infection or suppuration is intrathoracic. It shows extensive pathological shadows, of variable form and appearance. The images indicate the presence either of a pleural infection; total or encysted purulent pleurisy, hemothorax; or of a pleuropulmonary gangrene; or of a definite pulmonary accumulation: lung abscess. In all these cases, indication for operation is not only positive but urgent. It is a case in which surgery is indicated for pleuropulmonary septic complications, which are already well established and recognized, rather than surgery which has to do with war projectiles.

If, after intervention, the projectile is not discharged, the wounded came into one of the following groups:

(b) *Positive Indication (Not Urgent).* In the second group are included all those wounded who without any symptoms of serious infection or of apparent centers of suppuration have intrapulmonary projectiles which they do not stand very well.

In these patients there are seen clinically slight attacks of pulmonary congestion, or small pleural effusions, recurring hemoptyses, bronchitic attacks. Examination of the thorax shows diminution of resonance or even a definite dullness, modifications of sounds, increase or disappear-

³⁴ Annales de Méd., Paris, 1917, v, 473.

³⁵ Radio Diagnosis of Pleuropulmonary Affections, 1918, Yale University Press, translated by Honeij.

ance; rales, bronchi, fremitus, respiration a little shallow, most often no respiratory sounds.

From a functional point of view, these patients cough and expectorate, have dyspnea, especially on exertion, tachycardia, thoracic pains brought on or increased by coughing and walking. General health is poor; some have intermittent febrile attacks, others grow pale and thin; some have been considered tuberculous until radioscopic examination disclosed the presence of a projectile.

Radiological examination not only shows the presence of the projectile and locates it, but furnishes also valuable indications which show considerable diminution in the functional value of the lung affected.

Sometimes there is diffuse obscurity, not very extensive, limited to the area around the projectile or immediate vicinity. Sometimes the obscurity extends to all the lobes involved and sometimes even to the entire lung. Vesicular expansion produced by forced inspiration or by coughing has entirely disappeared while it remains in the other lung.

The extent of the excursion of the diaphragm in respiratory movements is limited; at times added pleural exudates obscure the base, partially or totally effacing the contour of the diaphragm, immobilizing it and filling up the costal sinus.

In all cases of this class it is clear that the projectile is the only cause of all the trouble. There is still positive indication for operation but it is not urgent. The location of the foreign body and the reactions produced must be studied all the time. Once all this knowledge has been collected, intervention can be undertaken.

(c) *Debatable Indications.* Finally, the third and last group includes foreign bodies which are well tolerated. A certain percentage of the wounded show perfect tolerance. One soldier was known to have had a large piece of shell (25 by 15 mm.) in the right lung for ten months, without experiencing the least discomfort; there was no apparent physical or functional disturbance on clinical or radioscopic examination.

Others possess less perfect tolerance and have very slight functional troubles, such as dyspnea on slight exertion, palpitation, thoracic pain, nervous reflexes; but have no cough, no physical sign on auscultation, no febrile reaction. Barjon believes that in some of these cases suggestion may play a part in causing these slight disturbances.

This third class includes more debatable cases, which, from the point of view of intervention, are acted on positively by some surgeons, negatively by others.

Marion and Duval believe positively in intervention. In their opinion every intrapulmonary projectile ought to be taken out because it may become the starting-point of a secondary infection, and because there is always a small center of suppuration around the projectile.

Certainly a projectile left in the lung, especially if it is of any size, is something abnormal, antisurgical and consequently disturbing. It is a solution which is not entirely satisfactory. From a military point of view, according to many, every man who knows he has an intrapulmonary projectile is lost. This argument, which may have some reason, is not actually a medical rule and will lose its value after the war.

A second class of surgeons do not believe in intervention. Certain projectiles are very well endured for a long time. Cases are quoted of fourteen to eighteen months' duration without any disturbance.

Intervention is not without danger. Cases of death have been reported. (Leriche's case with negative autopsy.)

Contraindications. Particular cases of contraindication have been specified by some surgeons. Mauclaire points out the deep location of the projectile in the region of the large hilus bloodvessels, which increases operative risk. Quenu points out as contraindication multiplicity of projectiles which complicates operative technic.

Finally, not all surgeons are of the same opinion regarding the local condition of the lung surrounding the foreign body. Some assert there is always a small center of suppuration. Others find in certain cases no trace of infection or suppuration. According to them, the projectile has been found in process of encystment in dense or entirely sclerosed pulmonary tissue. This finding has a great value because it shows that certain projectiles may become encysted in the lung, be surrounded by sclerous tissue and perhaps later by calcareous infiltration as in a healed tubercle. In that case they may be tolerated indefinitely. It is clear that to judge this question well a lapse of some years is necessary."

The After-effects of Wounds of the Chest. Much has been said about the treatment of gunshot injuries of the chest with particular reference to treatment in the evacuation and base hospitals. Only a few contributions have appeared concerning the end-results and the after-treatment of these injuries. The end of the war has brought this prominently to the fore, and we may look for frequent contributions from now on along this line. Meakins and Walker³⁶ report upon 70 cases from France where they had been under treatment for an average of four weeks. Careful notes were taken of the condition of the chest on admission. In 28.6 per cent. of the cases, no abnormal physical signs could be detected, although in all of these there was clear evidence of penetration. In the remainder, the examination revealed the following conditions:

	Per cent.
Collapsed lung	2.9
Thickened pleura	38.6
Fluid	12.8
Fluid and thickened pleura	12.8
Air	4.3

In all of the cases, except two, physical signs were quite typical of the condition which was supposed to be present, but it soon became apparent that percussion and auscultation were of but little value as an indication of the improvement, or otherwise, of the patient's condition. The most significant finding was the development in a varying degree of a distinct physical deformity varying from a simple muscular atrophy with, or without, drooping of the shoulder to a conspicuous contraction of the chest wall with curvature of the spine.

The deformity was measured by means of a height gauge which

³⁶ Canadian Med. Assn. Jour., 1918, viii, 910.

measured the height exactly on each side up to the acromioclavicular articulation and in this way gave the difference in level between the two shoulders. The outline of the chest was measured by the cyrtometer.

The deformity frequently appeared very early. The earliest was recorded two weeks after the date of injury. The first manifestation is a muscular atrophy about the points of injury. This may progress in a varying degree, so as to involve all the muscles of the chest wall and the shoulder girdle. It may even extend to the deltoid and muscles of the upper arm of the injured side. As a consequence of this atrophy, an early droop of the shoulders becomes apparent. The further deformity follows upon a falling-together of the ribs, which may be finally accompanied by curvature of the spine. At any stage the progress of the deformity may cease.

The determination of the cause of this deformity was recognized as of first importance. In view of the fact that the missile traversed, in all cases, the chest wall, the pleura, and the lung, it seemed probable that the deformity was the result of the injury to one of these.

In so far as could be determined, direct injury to the muscle produced in itself only slight atrophy, which was confined to the single muscle injured. In cases in which the ribs were fractured without signs of the involvement of either the pleura or the lung, any deformity which occurred was strictly dependent upon the local condition. If there had been loss of portions of the ribs, or if the fracture was not in proper alignment, a local deformity of greater or less extent naturally occurred; but if there was no loss of rib substance and the fracture was in good position, no deformity ensued. Furthermore, an analysis of the site of the wound showed that it was immaterial whether the injury was above or below the third rib, as there was practically an equal prevalence of deformity in either case. In no case did any general deformity result unattended by signs of disturbance of lung or pleura.

Meakins and Walker very carefully present the relation between the deformity and the degree and manner of involvement of the pleural cavity. The following table illustrates this point:

Deformity.	Pleura free, per cent	Hemothorax, per cent.	Pyothorax, per cent.	Pneumothorax, per cent.
Nil	57	39.5	7.0	0
Slight	37	39.5	40.0	50.0
Moderate	6	6.0	26.5	16.6
Conspicuous	0	15.0	26.5	33.3

A study of the individual records with reference to these complications leads them to explain the varying degree of deformity which may develop in cases suffering from penetrating gunshot wounds of the chest as follows: "Those cases in whom there is a simple perforation of the chest, without appreciable and persistent involvement of the pleural cavity, as a rule show some local atrophy of the muscles. The muscles are temporarily splinted, particularly if there is pain caused by respiration, and if a cough is present this splinting is accentuated. Furthermore, if the pectoral muscles or the latissimus dorsi be perforated, and move-

ment of the arm is also considerably restricted, the local atrophy becomes more conspicuous. Thus, there may be moderate drooping of the shoulders of the affected side, which frequently develops very early, the result of atrophy of the muscles of the shoulder girdle, apparently due to disuse. But the general conformation of the chest wall is not, as a rule, altered. A pronounced change in the shape of the chest wall appears only to develop when the pleural cavity is allowed to remain for a considerable period in an abnormal state. In addition to the immobility of the affected side of the chest, which is usually extreme in such cases, there is another factor to be taken into account—namely, the change of the intrathoracic conditions. When a part of the pleural cavity is occupied by blood (of varying concentration) for some time, organization eventually occurs. This organized material is adherent to both layers of the pleura, and, as contraction proceeds, compression of the lung and diminution of the volume of the intrathoracic contents occur. This is indicated first by elevation of the dome of the diaphragm. When this has reached a certain point, other factors prohibit its further extension, and, in consequence, the bony structures of the chest wall become involved. The ribs begin to assume a more oblique position and come closer together, until evidently the intercostal spaces are greatly diminished in width. Consequent with this collapse of the chest wall, the drooping of the shoulder becomes much more pronounced, and, if the contraction continues beyond a certain point, scoliosis of the dorsal spine develops, with the concavity toward the side of the injury. In some cases of extensive and persistent pneumothorax, a similar sequence of events occurs, even without such involvement of the pleura. In these cases the extensive collapse of the lung over a prolonged period allows carnification to occur, so that when the air in the pleura is eventually absorbed, the lung is incapable of expansion, and therefore the surrounding structures must contract to obliterate the potentially vacant space.

It was found that apparent deformity occurred more frequently and to a greater degree when the right side of the chest was injured. This was evidently due to the role played by the diaphragm. In right-sided lesions the elevation of the dome of the diaphragm was strictly limited by the liver, which acted seemingly like a cork. Beyond a certain point it could not go, while on the left side, although naturally limited, the degree of intrathoracic space which it could occupy was much greater than on the right side."

Treatment of the Deformity. Based on the principle that prevention is better than cure, a plan was evolved to splint the healthy side and force the affected one to do more work. The following series of exercise was adopted:

"1. The sound side of the chest is splinted against the back of a chair with the arm of this side extended as far as possible and grasping a rung. Then the patient is instructed to take deep slow inspirations, meanwhile pressing the healthy side against the back of the chair, in order to prevent expansion of the sound lung. In consequence, the injured side tends to expand more fully (five minutes). (Fig. 7.)

2. Dumb-bell exercises with a 4-pound dumb-bell in the hand of the affected side, and a 2-pound one in the hand of the unaffected side.

(a) Arms raising sideways and bending under to armpit and over to shoulder (five minutes).

(b) Lying on the back; arms raising from side to the vertical and lowering to the horizontal above the head (three minutes).

(3) Ladder exercises: The arm of the affected side is fully extended above the head and the highest possible rung of the ladder grasped firmly. The patient is then instructed to take deep slow inspirations, meantime pulling on the rung of the ladder with the arm of the affected side (three minutes). (Fig. 8.)



FIG. 7

It became apparent that the sooner the exercises were started the better. Therefore, when a patient had been out of bed for a few days and was capable of walking about without conspicuous distress, the first exercise was started, and, as he gained strength, the others were added. It was found that usually at the end of the tenth day of exercise a patient would be on the full schedule.

An essential part of the exercises was firm encouragement. The object of them was fully explained to the patient. On first commencing the course he was allowed to drop out and rest if he became at all exhausted. Such symptoms as pain and slight breathlessness were explained as being of no serious moment, and the former almost essential for recovery. It is very important that the physical instructor be

intelligent and interested in the cases individually, and be under the direct supervision of a medical officer. Also he should realize that the patients are in a curative stage, which may be marred by too strenuous process. When the patients became strong enough they were given general physical training in combination with the special exercises in order to reduce their 'hospitalization' as much as possible."

Meakins and Walker were well satisfied with their results. In those cases which had atrophy of muscles only, redevelopment was rapid and complete; even in those with more gross deformity, improvement was noted.

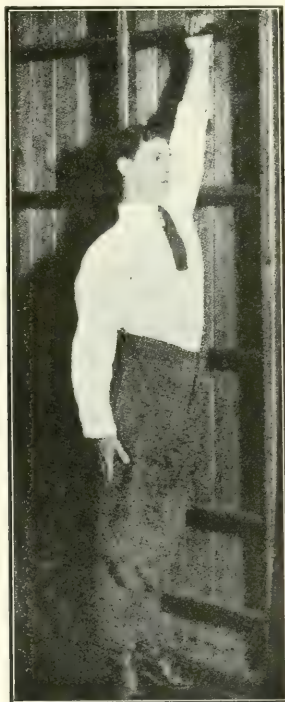


FIG. 8

They were able to observe the effect of a foreign body in the lung in 44 cases (63 per cent.), 35 of which were in the lung. In only one of the latter did any untoward symptoms arise, in this case an abscess developed in the upper part of the right lower lobe. A sinus developed and through this the foreign body was seized with long forceps and withdrawn, after which the patient made an uninterrupted recovery.

Of the 70 cases, 58 were discharged from the hospital, and, of these, 52 were considered fit for some form of duty, the great majority eventually for full duty. It is thus apparent that injury to the chest is not necessarily a conspicuous factor in invaliding soldiers from the Army.

The terminal stage of 50 cases is noted by Wilson.³⁷ On an average the cases were admitted eighteen days after being wounded. The results are best studied in two classes:

Non-penetrating. Seven cases of wounds of thoracic wall did not penetrate the pleura. Two of these had hemoptysis, 4 had hemothorax; of the latter 2 manifested pleuritic friction. One had a small swelling over the ribs due to incarceration of a piece of cloth; here also pleuritic friction was heard over adjacent area. This came on late in the course of illness, probably due to extension of inflammation. One developed pneumonia and another a persistent form of basal congestion or bronchopneumonia. Thus, concussion may cause hemoptysis, hemothorax, or pneumonia.

Penetrating Wounds. Most of these had hemoptysis, some for several days after they were wounded. Several state quite definitely that they did not spit blood and yet they presented physical signs of effusion. In 8 cases ribs were broken; in 4, a scapula; in 2, a humerus (1 requiring amputation at the shoulder); in 1, a clavicle. In 1, vertebrae were damaged; in 1 the esophagus was slightly damaged. In 3, the pleura had been sewn up; in 1, the diaphragm. In 16 cases the wounds were through-and-through; some of these had only short tracks through the lungs. Several did not present any physical signs of hemothorax. In 13 cases resection of rib was done for empyema. Several had physical signs of contralateral disease of the lung or pleura. Several cases with the physical signs of effusion were not aspirated, as there were no indications of sepsis; the physical signs gradually disappeared. Pleuritic friction was frequently heard in the later stages.

Twenty-eight, or more than half, returned to duty in from two to four months; 6 were discharged to Employments III, and 14 from the Army by medical boards, 6 in consequence of empyema, 4 in consequence of still having metal in the lungs, and 4 because of disabilities due to other injuries. One man had a sinus two inches deep between the lower ribs, left by some operative procedure, and into this iodoform and bismuth paste was injected; immediately coughing was provoked, and within a few seconds he coughed up pieces of paste the size of pea. The sinus healed in a few days. Two patients died from septic pneumonia.

Empyema. A glance at the reviews of the literature on "Empyema" during the year preceding the war shows that there was a certain repetition year after year, a monotonous recital of the high mortality, the need for earlier diagnosis, and a shifting of opinion regarding "inter-rib," or "rib-resection" drainage. The positive and negative pressure work stimulated some interest, and the radical operation of Lilienthal excited discussion. Then came the war and the possibilities of infected pleurae from foreign bodies or infected blood clot. This literature was reviewed in the 1917 and 1918 issues of PROGRESSIVE MEDICINE. This year, however, we have the extremely interesting and prolific group of empyemata following lobar pneumonia and bronchopneumonia com-

³⁷ Lancet, 1918, xi, 102.

plicating measles or influenza, and caused either by the pneumococcus or streptococcus.

I do not believe that anything comparable to this epidemic has ever occurred before; the high mortality, the widespread pathology, the unusual and unique symptom-complex. We have not the space to go into the details of the etiology nor to more than mention the diagnostic features. The most important reports have appeared from the Base Hospitals attached to the camps and they will be freely quoted in this abstract.³⁵

"Three periods characterize the epidemic as to time and virulence: First, the period of November, December and January, which marked the greatest intensity of the disease. At this time a typical clinical picture is that of a patient convalescent from measles, who, after exposure, develops thoracic oppression and dyspnea. There is a slight lividity, deepening into cyanosis, with evidence of a rapid out-pouring of serum into one or both pleural cavities and perhaps also into the pericardium and peritoneum. Loud, moist rales are heard over the chest, and the respiration grows progressively more difficult and more superficial. The effused fluids teem with streptococci, and at times the microorganism may be recovered from the circulating blood. In from twenty-four to seventy-two hours the patient is dead. At the postmortem the lungs show large areas of congestion and edema. There is some purulent bronchitis and peribronchitis. In some cases the lungs are necrotic. The effusions in the serous cavities are seropurulent. The process is so rapid that a definite pneumonic process of true pyothorax usually is not found. After the onset of the disease the patient is usually too weak to stand any formidable operation, and has an infection too generalized to be benefited by simple aspiration. Should the patient, however, survive the early stages of infection, consolidation of lung, pulmonary abscess, and purulent infection of the various serous cavities may occur.

"The second period of streptococcus infection, as to virulence, began the latter part of February and extended into April. While serious, the epidemic had lost its intense virulence, and the patients lived long

³⁵ The following is the list of reports in the literature up to December 1, 1918:
 Zachary Taylor: *Hamburger and Mayers, Jour. Am. Med. Assn.*, 1918, lxx, 915.
 Sam Houston: *Cole and MacCallum, Jour. Am. Med. Assn.*, 1918, lxx, 1146.
 Denvens: *Davis, Jour. Am. Med. Assn.*, 1918, lxx, 1525.
 Pike: *Dick, Jour. Am. Med. Assn.*, 1918, lxx, 1529.
 Pike: *Small, Jour. Am. Med. Assn.*, 1918, lxxi, 700.
 Pike: *McKenna, Jour. Am. Med. Assn.*, 1918, lxxi, 743.
 Dodge: *Miller and Husk, Jour. Am. Med. Assn.*, 1918, lxxi, 702.
 Dodge: *MacCullum, Jour. Am. Med. Assn.*, 1918, lxxi, 704.
 Lee: *Empyema Commission, Jour. Am. Med. Assn.*, 1918, lxxi, 366.
 Sherman: *Rinehart and Oelgoetz, Jour. Am. Med. Assn.*, 1918, lxxi, 274.
 Meade: *Thomas, Jour. Am. Med. Assn.*, 1918, lxxi, 1307.
 Sam Houston: *Clendenning, Am. Jour. Med. Sc.*, 1918, clvi, 575.
 Reilly: *Stone, Phillips and Bliss, Arch. Int. Med.*, 1918, xxii, 409.
 Sevier: *Vaughan and Schnabel, Arch. Int. Med.*, 1918, xxii, 446.
 Upton: *Brooks and Cecil, Arch. Int. Med.*, 1918, xxii, 269.
 Custer: *Beals, Zimmerman and Marlow, Jour. Infect. Dis.*, 1918, xxiii, 475.
 MacPherson: *Babcock, Med. Record*, 1918, xciv, 751.
 Lewis: *Rocky, Military Surgeon*, 1918, xliii, 384.

enough to develop other lesions. Usually, the patient did not develop the acute and tragic symptoms, and the serous pleural effusions progressed after from several days to one or two weeks to a purulent stage. Pneumonic consolidations and pulmonary abscesses not infrequently occurred, and metastatic effusions in other large serous cavities or in the joints. In the joints the results varied from complete disorganization to spontaneous subsidence with only moderate stiffness. At times there were pyemic manifestations, including multiple subcutaneous abscesses of mild virulence containing streptococci, and promptly healing after simple incision, as in typhoid fever. The presence of streptococci in the blood, while ominous, was not always of fatal import.

"In April, the third stage of the epidemic was observed. While the *Streptococcus hemolyticus* was still the predominating organism, a pyothorax was the chief lesion, but it usually was amenable to treatment, and death was rare.

"The virulence of the epidemic, therefore, bore a direct ratio to the coldness of the months, and the microorganisms also apparently progressively attenuated as the epidemic advanced. Not only were the infections more severe and more fatal in the early winter months, but they were more enduring and more resistant to treatment, so that empyemas starting in the early winter not infrequently continued to drain until spring or summer, while those beginning late in the epidemic often closed first." (Babcock.)

In the fall of 1918, the influenza epidemic was followed by another wave of pneumonia and empyemata but, in so far as I can learn, it is not comparable in severity nor in frequency with the earlier one.

In a report from Camp Custer, compiled by Beals, Blanton and Bresnahan, it is shown that the incidence of empyema as a complication of pneumonia was only 3.1 per cent. and that the mortality was only 6.1 per cent. The cases were not fulminous in character and many cases showed thick pus at the first aspiration.

Diagnosis. There is but little to add at this time to the well-known physical signs of pleural effusion; troubles in diagnosis were the result of the associated mediastinal edema and suppuration. The following sentences from the article by Vaughan and Schnabel are important:

"There are two periods during the course of acute lobar pneumonia at which the signs may very strongly suggest a pleural effusion which is, in reality, not present. The first is early in the disease when the signs of consolidation have not developed fully and when there may be dulness, but usually not real flatness, with suppression of the breath and voice sounds. If the beginning consolidation is in the lower lobe, fluid may be strongly suspected. In 15 of our cases, these signs were present. The second, and more important, period is at, or about, the time of crisis and resolution. Following the presence of dulness, bronchial breathing and bronchophony, there may develop distant bronchophony and dulness to flatness over the same area. Thoracentesis will be non-productive and on the same day or soon thereafter, the temperature will suddenly drop to normal, where it will remain. We know of no accepted anatomic explanation for this phenomenon, but suggest that

with beginning resolution more air enters the central portion of the lobe, in the region of the larger bronchi, and, consequently, the bronchial breathing and bronchophony become less distinct. The still considerable amount of consolidation accounts for the persisting dullness. As the resolution progresses, this dullness also clears up. We have had 12 such cases in which fluid was suspected and some of which were tapped, with negative results."

"Too great emphasis cannot be laid on the statement that if one is convinced, from the signs and general conditions, that fluid is present, needling should be persisted in even though no fluid be at first obtained.

"Another maneuver in the successful demonstration of fluid is in directing the needle in more than one direction after it has once been inserted. One more point to be borne in mind is that, before tapping, the patient should be so placed that the suspected area is as nearly as possible the dependent area." (Vaughan and Schnabel.)

"In performing pleural puncture, it has been found beneficial to remember that the diaphragm may be higher on the affected side than is commonly believed, due to abdominal distention. The point usually selected was over the area of greatest dullness, after outlining the upper limit of the liver in front and side if puncture was to be done on the right side. Behind, below the angle of the scapula, or laterally in the post- or midaxillary lines, were the usual locations for puncture. In accumulations in front, the nearer the puncture to the sternum, the greater the danger because of the internal mammary artery and the larger vessels." (Stone, Phillips and Bliss.)

The physical signs, the aspirating needle, and the x-rays are the three diagnostic props in empyema. The x-rays, in the early stages, cannot entirely be relied upon to demonstrate the existence of fluid. Davis calls attention to the use of the upright position in making x-ray examinations, allowing the fluid to gravitate to the bottom. In the recumbent position, the solidified lung does not compress and the fluid spreads out over the whole cavity. In the pneumonic infections and particularly those seen in civil practice the empyema rarely appears until after the lung begins to clear up.

Pus Pockets. In a number of the camp hospitals, localized pus pockets proved annoying, both to diagnosis and treatment. For instance, at Camp Custer fluid has been aspirated from different pockets in various locations, just inside the right nipple, high and low in the axilla, near the sternum, beneath the clavicle, mid-scapula region, and at the extreme base. One pocket was located at a depth of 2 inches in the interlobar fissure; another cylindrical pocket extending from the surface to a depth of 5 inches, more of a sinus than a pocket the size of a finger, with the end of the cylinder at about the angle of the scapula. The pocket formation may be the result of old or new adhesions. It has been possible, in several cases in which yellowish-gray pus was draining from a chest, to find on thoracentesis only a few centimeters away, a considerable quantity of slightly turbid lemon-yellow fluid from another pocket. At Camp Dodge they found "particularly important, from a surgical point of view, the adhesions, which occur in such a way as to

imprison part of the exudate. The anterior margin of the lung may adhere to the pericardial sac and thus enclose a quantity of pus between the lung and the pericardium, or two lobes may imprison a pocket between this." Or again, to quote from McKenna:

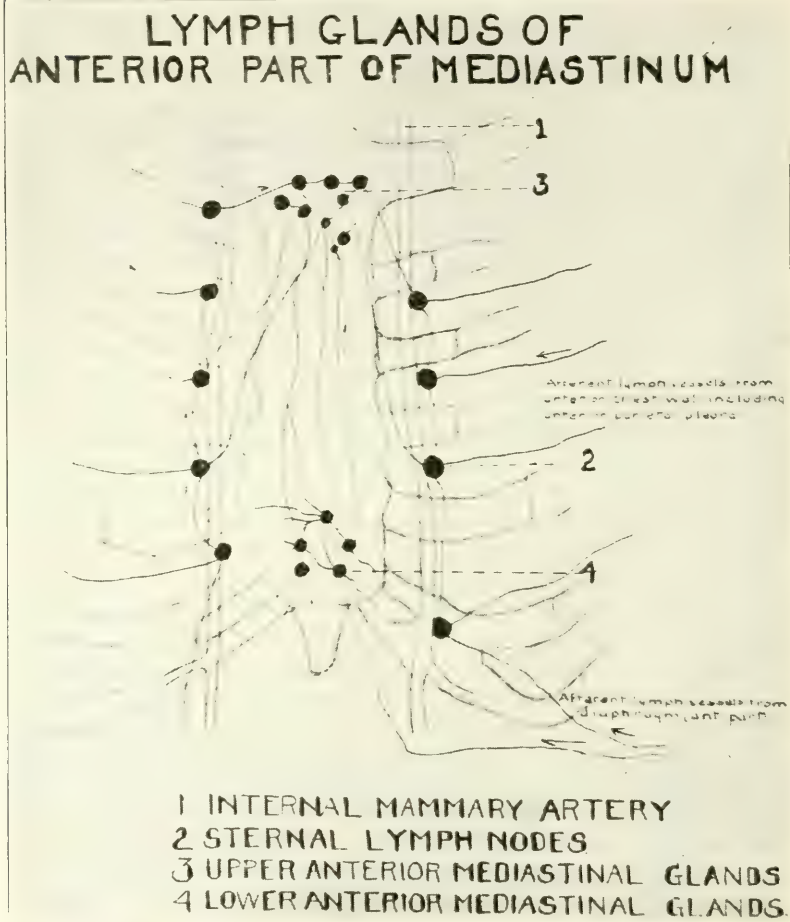


FIG. 9. —Diagrammatic representation of the lymph glands anterior to the mediastinum indicating possible location of pus pockets. (Stone, Bliss and Phillips.)

"Of special interest were the pus pockets formed in the following position, the lateral wall on the right side formed by the mesial surface of the lung from the diaphragm to the apex of the lung, the left wall below by the pericardial sac, above by the mediastinal space, and in front by the anterior flap of lung, which became adherent to the costal pleura in this position, thereby burying the pus deep in the thoracic cavity about the roof of the lung. Cavities containing pus formed in a corresponding position in the left pleural cavity."

The explanation of these loculated empyemata is attempted by Stone, Bliss and Phillips, who encountered a substernal collection in 29 instances in 153 necropsies. They state that the presence of these collections was suspected in many instances but was not actually diagnosed in any case. (See Fig. 8.)

"This pocket of pus, which is usually situated on the side of the affected lung, but which may be bilateral, lies immediately beneath the sternum. It occupies the space between the median flap of lung composing the upper lobe as it lies above the fibrous layer of the pericardium. It is not in the mediastinum and should not therefore be called a mediastinal abscess. The term subcostosternal pocket describes the location and its boundaries. The pocket may communicate with other septal pockets or other portions of the pleura of the affected side. The vessels of the hilum may be its deepest limit, or the opening to the pleura may occur through the normal pulmonary septa. This pocket is almost impossible to drain laterally, anteriorly, or posteriorly by the usual thoracotomy or costatectomy. This pocket may be primarily affected, and all other portions of the pleura be apparently free from pus while this one alone remains undrained and unhealed.

"If the infection traveled by way of lymphatic vessels from the lymph spaces in the alveoli of the lung and perivascular and perobronchial lymphatics, it would reach the middle mediastinal lymph glands just below the bifurcation of the trachea, from which it would communicate to visceral nodes in the anterior and posterior mediastinal spaces and would produce a mediastinal abscess. We believe that the course of the infection is parietal rather than visceral, that it follows the lymph channels to the pleura from which afferent lymph vessels, draining the anterior chest wall, including the anterior parietal pleura, lead to sternal lymph nodes of which there are usually six on each side along the course of the internal mammary arteries. The pus pockets occur in close proximity to these nodes due undoubtedly to breaking down of these glandular structures. They have constituted a unique and very serious complication."

Treatment. I do not believe that anything new has as yet appeared regarding the technical points. There has been much argument regarding the time to operate, much discussion as to whether simple thoracotomy or rib resection should be done and the advocacy by some of suction methods in the after-treatment. There is nothing new about this, and in these pages year after year we have given space to papers bearing on these very points. It is most important to hold in mind the peculiar type of infection, overwhelmingly streptococcic, that characterized most of the empyemata in the first epidemic. Babcock has put it well:

"Irrespective of the treatment it is evident that the late cases were much less virulent and much more amenable to treatment than those of the early months of the epidemic. Not only this, but patients bore the larger thoracoplastic operations or decortications much better in the spring than in the winter. Statistics on methods of treatment which do not take into consideration the rapid attenuation of bacterial virulence

as the epidemic progressed have little value. To this attenuation we may largely ascribe the wide diversity of surgical opinion."

The "Empyema Commission," after commenting upon the difference between the pneumonic and streptococcic empyemata, states that, in the latter, early operation is inadvisable, (a) because of the danger of collapse of the lung from pneumothorax; (b) because of the great danger of producing a blood-stream infection from absorption of streptococci from the surfaces of the fresh wounds; (c) the desperate state of the patient. At Fort Riley, early operation was performed on all empyemas during the period October 18, 1917, to January 29, 1918; 83 patients were operated on, of which 52 died, a mortality of 63.8 per cent. Beginning January 12, *the method of treatment was changed* in several particulars as follows: As soon as the diagnosis of empyema was made during the course of pneumonia, aspiration was done every alternate day until the pus became too thick for aspiration. At this time, usually after the lapse of twelve to twenty days, the clinical judgment of two or three physicians was sought as to the advisability of operation. If it was not considered that the patient's condition warranted operation, intrapleural lavage was practised at the time of aspiration, in closed circuit, by connecting a bottle containing warm saline solution to the aspirating tubing. The pus was so diluted as to permit of aspirating. Eleven patients recovered by repeated aspirations without operation, after from one to ten aspirations.

If operation was done, a Brewer tube was used for drainage, and was attached to a partially collapsed Ewald bulb. Since January 12, 1918, neutral solution of chlorinated soda (Dakin's solution) was used for the daily irrigation of empyema wounds, resulting in a lessening of the odor and the amount of discharge.

	Cases.	Deaths.	Per cent.
Late operation preceded by repeated aspiration	80	13	16.2
Early operation not preceded by aspiration	85	52	61.2
Pneumonia with empyema unoperated ³⁹	81	70	86.4

Rib-resection was done 76 times, simple thoracotomy 43 times; local anasthesia was used in 102 cases, general in 17.

Much will be written about this matter of early *versus* late operation but the following figures are highly illuminative. Graham, in a report to the Surgeon General from answers to a questionnaire, found the average mortality of empyemata to be 30.2 per cent. In those hospitals where immediate drainage was advocated, it was 31.8 per cent., and in those practising delay (aspiration only) it was 31.6 per cent. Simple thoracotomy gave a mortality of 39.4 per cent. and rib-resection a mortality of 31.3 per cent.

Technic. There is nothing of importance that is new, only a few minor variations in standard technic have been introduced. The simple puncture method, practically that known as Perthes' method, has many advocates. The objections to this method in the past have been that

³⁹ Those patients who were not considered reasonable operative risks, or in whom the condition was not diagnosed prior to necropsy.

the coagulating exudate blocks up the tube and drainage becomes impossible. It seems, however, that Dakin's solution breaks up these masses and liquefies the pus so that a small tube is perfectly feasible.

The following is from McKenna: "The pleural cavity is drained, irrespective of the character of the pus, by means of a No. 14 French rubber catheter, introduced by means of a trocar and cannula, just large enough to thread the catheter into the pleural cavity. The catheter is then connected with a 100 c.c. glass syringe, and aspiration is intelligently and carefully carried out. If the pus is too thick for aspiration, a small amount of neutral solution of chlorinated soda (Dakin's solution) is allowed to run in. This solution quickly liquefies the pus, so that by repetition of this procedure the entire cavity is emptied. The cannula is withdrawn, leaving the catheter in place, and one-half the number of cubic centimeters of Dakin's solution are allowed to run into and remain in the pleural cavity as correspond to the quantity of pus aspirated during the operation. The process of aspirating through this catheter and the instillation of Dakin's solution are repeated by a trained ward surgeon three times a day, and twice during the night by an especially trained nurse. When the examination, either physical, by the roentgen-ray or by aspiration, shows that separate pockets of pus exist, this same procedure is followed."

Resection of the rib, followed by irrigation through Carrell tubes, is practised at the Rockefeller Institute Hospital. The technic and results as given by Stewart⁴⁰ are as follows:

"The site of operation in most cases where the fluid seemed to be evenly distributed has been at the lowest point posteriorly and in most cases over the eighth or ninth rib in the posterior axillary or scapular line. In those cases where a definite localized pocket was found the opening was made over the region of the pus.

"In the early cases the pleural cavity was not flushed out at operation. Three to five Carrel perforated tubes were placed in the cavity extending to all points and two large, short tubes inserted in order to have a free outflow of secretions and chlorinated material. With our later cases the pleural cavity has been flushed with Dakin solution at the time of operation, the large tubes have been omitted and four Carrel tubes stiffened with fine silver wire have been placed, endeavoring to reach all parts of the cavity. Compresses wet with Dakin solution were placed in the external wound to the pleural opening, replacing the large tubes originally used in order to prevent a too rapid interchange of air. After placing the tubes and compresses, x-ray examination showed that the tubes reached all parts of the cavity.

"In the early cases instillations of 30 to 60 c.c. of 0.2 per cent. sodium hypochlorite solution were given every two hours for forty-eight hours, and as no contraindications arose in the use of this solution, the strength was increased to 0.5 per cent. sodium hypochlorite, or full strength Dakin solution. In our later cases instillations have been given every hour during the day and every two hours during the night, and the

⁴⁰ Med. Record, 1918, xciv, 236.

amount has been increased to from 80 to 100 c.c. Dakin solution. This has been done to more closely follow the necessary principles of time, concentration and contact in the use of an antiseptic.

"Dressings are made daily. A smear from the inside of the pleural cavity is taken to be examined microscopically, the cavity flushed out, the individual tubes tested, and fresh tubes inserted when necessary. Compresses wet with Dakin solution are then placed in the external wound as at operation, the skin protected with vaseline compresses or zinc oxide ointment, and a cotton pad and chest binder applied. The external dressings are changed by the nurse when necessary.

"In our early cases closure took place spontaneously in from three to seven weeks, no attempt being made to suture the wounds. In the latter cases, however, we have made secondary closure with suture when sterilization was obtained as shown by the bacteriological curve, and in some cases by culture as well. Cultures taken at the time of dressings have been found sterile at the end of six to nine days. Secondary closure was made in the following matter: The skin was anesthetized with novocaine, skin edges of the wound freshened, granulation tissues not disturbed; suture through the skin and fascia was made with silk-worm gut, care being taken during closure to prevent any blood from entering the pleural cavity. In this way we were able to close cases by suture in from five to twelve days or more, the average time being about fourteen days. Primary union was obtained in about 70 per cent. of the cases. Where secondary sterilization was necessary this was readily obtained in all cases in a week or less, and complete closure was the final result. The secondary infections were always found to be of a low virulence.

"After operation the patients were comfortable and were, in general, free from the toxic symptoms present in most empyema cases. All patients have been put on full diet as soon as possible following operation. The secretions have been small in amount and free from odor. The temperature has dropped as a rule after operation, and in the few cases where it has remained elevated it was due to the pneumonic process which was still active, or to complications, as practically all of our cases were operated on before a crisis or lysis. Lung exercises were given as soon as possible after operation."

CASES TREATED.

	Cases.	Deaths.	Per cent.
Streptococcus infection	32	9	28.12
Pneumococcus infection	9	2	22.22
Mixed	4	1	25.00
Total	45	12	26.66
Cases discharged, 22.			
Cases in hospital, 11; 4 ready for discharge.			

It does not matter which method is used, routine examinations of the pus each day must check up the treatment. I believe that with due regard for the two infections—streptococcic and pneumococcic—success, and a low percentage of chronic cavity are decided by the personal care and study given to each case.

There is not sufficient space to pursue this subject further this year. Other papers on empyema have appeared, notably those of Whittemore,⁴¹ Homans,⁴² Dunham.⁴³ Homans offers a new suggestion, viz., that it is possible by a study of the cavity, to prognosticate the need for radical surgery. He says that "if attachments of the lung occur in such a way as to leave the surface of the collapsed lung convex after drainage, complete expansion cannot occur. If, on the other hand, the lower angle of the lung becomes fixed at or near its natural position so as to leave the outer face of the lung concave, that concavity can quite readily belly out and become applied as a convex surface to the chest wall."

Postoperative exercises are of the greatest importance but here we need only refer to the article by Meakins and Walker.

Sliding Skin Flaps in Lung Abscess, etc. Beck⁴⁴ proposes a method for the treatment of old abscess and empyema cavities which is not so severe as the Estlander operation and which has been successful in his hands.

The patient is placed in a semirecumbent posture and anesthetized. Before incising the skin a rubber catheter is introduced into the existing sinus and kept there as a guide during the first part of the operation. The skin incision differs in almost every case. It depends entirely upon the location of the abscess or emphysema. He has devised and employed three different types of skin incisions, the Y shape, the X shape, and the trapdoor incision. Each of these incisions is illustrated schematically (Figs. 10, 11 and 12).

Each of these incisions forms one or more flaps of skin of various lengths, which are intended for implantation into the lung abscess after it has been exposed. The skin is not dissected from the underlying fat or muscle until we are ready to implant it into the abscess cavity.

From three to five ribs overlying the abscess cavity are now widely exposed and as many are resected as seems necessary to expose the lung abscess to its full extent. In cases of empyema even more than five ribs may have to be resected. One should not hesitate to remove as much rib length as seems feasible, four to seven inches of each if possible. In cases of empyema, where the cavity usually extends into the apex, we should endeavor to include the third rib in the resection if possible. This will facilitate the implantation of the skin flap into the very recess of the apex of the pleura, and prevent the granulation of this recess which occurs when the skin flap does not cover it completely.

The ribs removed, a small incision of the thickened pleura is made along the catheter, the finger is introduced into the abscess cavity and the cavity explored.

The incision of the pleura is extended upward to the highest point, without cutting into the lung, and then the cavity is fully exposed to ocular inspection by removing as much of the parietal pleura as possible. This will usually make the opening into the abscess cavity large enough to introduce the entire hand.

⁴¹ Boston Med. and Surg. Jour., 1918, clxxvi, 360.

⁴² Annals of Surgery, 1918, lxxvii, 697.

⁴³ Surg., Gynec. and Obst., 1918, xxvi, 259.

⁴⁴ Ibid., lxxviii, 148.

In most cases of chronic empyema, the lung will be found retracted upward and inward. At times the apex will contain functionally normal lung. In the cases of lung abscess, however, the matter is different. The globular or multilocular cavity, with thick septa, exists into which

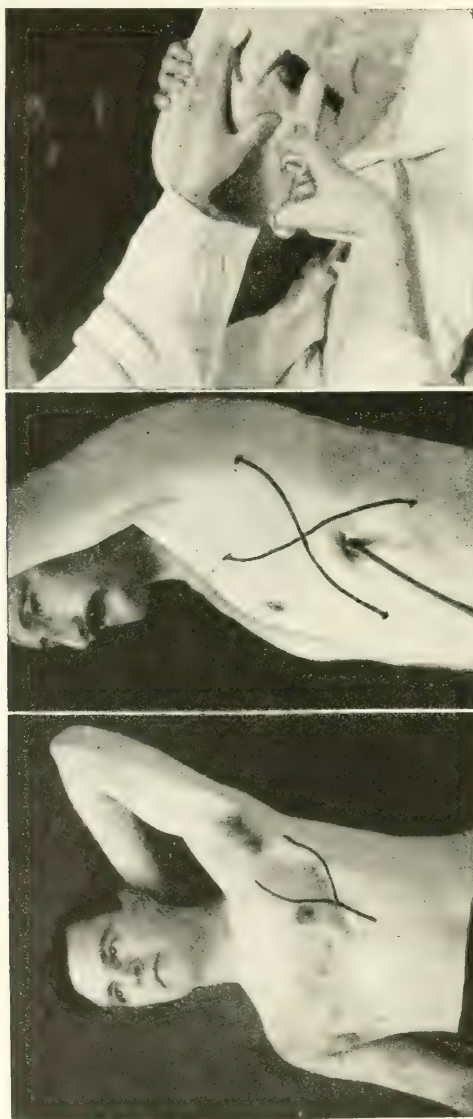


FIG. 12

FIG. 11

FIG. 10

FIG. 10.—Y-shaped incision for empyema, cavity high.

FIG. 11.—X-shaped flap incision for very large cavities.

FIG. 12.—“Trapdoor” incision for lung abscess, when posterior.

frequently open one or more bronchi. In one of my cases seven bronchi opened into one lung abscess. (Case shown at the Western Surgical Association in 1914.)

The cavity being fully exposed, it should be swabbed with dry gauze and the usually smooth surface of the abscess wall sufficiently scarified

either by rubbing it roughly with gauze or even resorting to a mild curettage. This is done for the purpose of producing a favorable condition for the adhesion of the skin flap.

The cavity being dry, the tips of the skin flaps are drawn into the very deepest recesses by means of forceps. Gauze is packed tightly against them, to keep them in contact with the raw surfaces of the abscess cavity. No suture whatever is used.

The denuded surfaces from which the skin flaps are taken are then covered with sterile gauze, and no attempt is made to reduce the size.

Where bronchi communicate with the abscess cavity the actual cautery should be used to destroy the mucous membrane.

If the abscess cavity remains widely open, the cauterization of the bronchus may be done subsequently at different sittings. The procedure is entirely painless and causes no other discomfort than the irritation produced by the smoke from the burning flesh, drawn into the trachea and nostril during inspiration.

The correct after-treatment in these cases is of the utmost importance. The gauze packing should not be removed for forty-eight hours. After this period the skin flaps will usually have become firmly adherent and the gauze packing can be safely removed without detaching them, although great care should be taken against such a mishap. A spatula should be pressed against the skin flap, while the gauze is being pulled out. No irrigation or medication is necessary, merely careful packing. This should be repeated daily and it will be noticed that the cavity is growing smaller from day to day and that the skin is gradually growing from the edges of the skin flaps, paving the cavity by degrees.

The most gratifying observation is the fact that the reduction of the size of the cavity is not due to filling of granulation tissue but rather to the expansion of the underlying lung, so that after a period of several months the skin flaps which were deep down in the cavity are now very much nearer the surface of the chest and only a shallow depression or a short funnel eventually remains.

Pneumothorax Treatment for Lung Abscess. Tewksbury⁴⁵ calls attention to the poor prognosis in the non-tuberculous lung abscess and reports in his two communications 10 cases treated by the production of a pneumothorax. In PROGRESSIVE MEDICINE for 1917, I collected a number of cases in lung abscess following operation on the nose and throat. Tewksbury briefly summarizes the clinical symptoms:

The infection is of the usual mixed type, with the staphylococcus and streptococcus predominating. There are two theories as to the mode of infection: (1) The infecting organisms are carried into the lung by the direct aspiration of infected blood, due to a partial paralysis of the epiglottis while the patient is under the anesthetic. (2) The infecting organisms are carried into the lung from the field of operation by means of an infected clot, with a resulting septic infarct. The symptoms appear from four to ten days after operation, and begin with a rise in temperature, dry cough, pain in the chest on the affected side,

⁴⁵ Jour. Am. Med. Assn., 1917, lxxviii, 770; 1918, lxx, 293.

and profuse sweating. Blood examination shows a leukocytosis, and physical examination reveals dullness with diminished breathing over the abscessed area. From one to two weeks after onset of the symptoms, the abscess ruptures, and a large amount of foul pus is coughed up.

Of the 10 cases treated by Tewksbury, 6 patients, or 60 per cent., were cured; 2, or 20 per cent., were only temporarily improved, and 2, or 20 per cent., died. Of the 10 patients treated, 7 had the abscess in the right lung and 3 had the abscess in the left lung. In 4 cases in which the abscess was of less than two weeks' duration a prompt cure was effected. In 6 cases in which the abscess was of longer duration, 2 patients were cured, 2 were temporarily improved and 2 died.

Tuberculous Abscess of the Thoracic Wall. Sinuses of the chest, especially if indolent and chronic, are usually believed to be costal in origin and tuberculous. Robinson⁴⁶ offers a brief contribution showing that a cold abscess of the chest wall may exist without any involvement of the rib; also, that an erosion or necrosis of the rib may be merely incidental to a primary lesion of the pleura, and that its removal as such may be inadequate treatment of the lesion; that excision of the rib should be employed not as a *sine qua non* of the operative treatment, but as an incidental step in the scrupulous exploration of the fistulous tract and in the wide open drainage of the subcostal abscess cavities with which the tract generally communicates.

Another contribution upon the same subject discussing the treatment of diseased costal cartilages has been written by Moschcowitz.⁴⁷ He takes as an example the case of a patient presenting himself with an abscess in the chest wall which is diagnosed usually as tuberculous, sometimes as typhoid in origin. It is either incised or perforates spontaneously. In either event, a sinus remains which continues to discharge smaller or larger amounts of pus. The discharge is persistently examined for tuberculosis and then appears the third stage which may be called the "stage of the curette." Fistulae and the underlying cartilage are curetted and the wound dressed with iodoform, etc. This may be done several times and several discharging sinuses make their appearance. Often a large incision is now made and all of the granulated tissue curetted out and the cartilage scraped or partly removed. Again the wound does not heal, and again a sinus forms. It is only when all of the cartilage has been removed by repeated operation that the surgeon finds to his immense satisfaction that the wound has permanently healed. After an experience of several cases such as this, Moschcowitz came to the conclusion that cartilage may be traumatized or infected to such an extent as to become devitalized beyond the possibility of recovery. Such cartilage takes a very long time to become exfoliated. The technic of treatment is therefore self-evident. It means the removal of every trace of cartilage that has at any time, either before or during operation, become uncovered of its perichondrium. He advises an incision extending parallel with the free border of the ribs and extending from the midsternum to well beyond the costochondral junction of the eighth rib.

⁴⁶ Trans. Assn. for the Study and Prevention of Tuberculosis, 1917, 170.

⁴⁷ Annals of Surgery, 1918, lxxviii, 168.

INFECTIOUS DISEASES, INCLUDING ACUTE RHEUMATISM, CROUPOUS PNEUMONIA AND INFLUENZA.

BY JOHN RUHRÄH, M.D.

NOTWITHSTANDING the fact that it has been impossible to review the same number of journals as in previous years, there have been a large number of interesting and important contributions—so many, in fact, that it has been impossible to notice any considerable number, as many of the articles deal with the same subject. As is usual, interest has centered around certain diseases. In the first place the splendid contributions on the etiology of trench fever by the American Commission under Strong, and also by an English Commission headed by Byam, deserve special comment. The epidemic of influenza has led to a perfect flood of contributions on this subject, most of which at the present time are more or less unsatisfactory, inasmuch as the question of etiology remains unsettled. As was to be expected, the bringing together of large numbers of troops in training camps has resulted in epidemics of various diseases, and while the typhoid group of diseases seems to have been done away with, there has been no lack of morbidity and mortality in the past year, chiefly due to respiratory infections. This has led to a more careful study of pneumonia, particularly the epidemic form, with certain suggestions as to the prevention and treatment and to tentative reports on the use of vaccines. The diphtheria toxin-antitoxin method of producing immunity has finally become established, and particular attention is called to the review of a most excellent article by Zingher.

Along the line of preventive medicine, the prevention of chicken-pox deserves notice. While this will probably not come into general use, nevertheless, for institutions harboring large numbers of children, it will undoubtedly be of considerable value. The use of lipovaccines may also be mentioned. The subject had not received much attention in this country until the past year. The control of respiratory infections by use of the gauze mask is another subject which has received its due share of attention. One might also call attention to the studies on epidemic jaundice, and a better understanding of the treatment of cerebrospinal fever, and to certain contributions on the subject of poliomyelitis of which due notice is given below.

Communicable Diseases in the Army of the United States. Vaughan and Palmer¹ made a study of this subject for six months, from Septem-

¹ Journal of Laboratory and Clinical Medicine, August, 1918, vol. iii, p. 635.

ber, 1917, to March, 1918. The mobilizing of a large army is always associated with an increase in the morbidity and mortality, as the gathering together of a large number of men in a central camp acts like a dragnet in bringing to a point all infections prevalent in the area from which the men came. The wider the area from which the army is assembled, the greater will be the morbidity and mortality from communicable diseases, and this is also influenced by the susceptibility of the individuals, those from the country districts showing a much greater tendency to infection than those from cities and the morbidity will also be greatly influenced by the crowding and intimate contact and also on the virulence of infections and the number of carriers.

In less than one year 1,000,000 untrained and undisciplined men, most of whom were ignorant of personal hygiene and without any previous experience in looking after themselves under conditions in which they had to live, were brought together in close contact, and it is only reasonable to suppose that the number of cases and deaths would be more than they would be in civil life. When, however, one studies the figures and the death-rates between military and civilians, one finds that the nearest approach that can be made is to study the period between twenty and twenty-nine years of age, which is the nearest corresponding to the draft age of from twenty-one to thirty-one years. In this group the death-rate is greater among males than among females, and it should be remembered that the army includes men above and below the draft age. The death-rate per 1000 in the army was 9.1, which is higher than for similar ages in any other city with the exception of New Orleans, in which the death-rate was 10.4, New York and St. Louis being 5.5 and Chicago 5.2. The average in the United States registration area is 5.7 for the ages between twenty and twenty-nine. It must also be borne in mind that in the army certain of the camps acted as filters and a very considerable amount of material was weeded out, and that the morbidity and mortality rates at these camps suffered, among which may be noted Camp Funston and Camp Pike, whereas in Camp Wadsworth the camp was practically closed, and it is interesting to note that 1500 select men from Camp Taylor, who were transferred to Camp Wadsworth, came from the mountains of Kentucky and Tennessee and they brought with them pneumonia and meningitis and some other diseases, and soon had a rate of 79 per 1000 as compared with 44 per 1000 of the New York troops than had been in the camp, most of whom came from the larger cities of New York. In all the camps the accessions of unseasoned men were followed by a rise in the morbidity curve of all diseases, and especially in the diseases that were transferred from the respiratory organs. This was probably partly due to the fatigue and overcrowding incident to the journey to the camp and perhaps also to the change in the mode of living first lowering their resistance.

It was found that under similar conditions the negro is more susceptible to the acute respiratory infections than the Northern white man. For example, at Camp Dodge the death-rate among the negro troops from pneumonia compared to white was as 4.4 is to 1. The white troops from the South are also more susceptible to pneumonia than those from

the North. This is a well-known fact and has been noted by Flint, and has also been the experience of the French with their African troops.

In the respiratory group of diseases are included pneumonia, meningitis, measles, scarlet fever, diphtheria and tuberculosis. In civilian life in the United States registration area during the six winter months of 1915, in the ages of nineteen to twenty-nine years inclusive, these diseases caused 43 per cent. of all the deaths, whereas in all the troops of the United States from September, 1917, to March, 1918, these diseases caused 77 per cent. of all deaths.

CAUSES OF DEATH IN THE UNITED STATES ARMY FOR SIX MONTHS.

Pneumonia	61.5
Other diseases than here mentioned	15.3
Meningitis	12.0
External causes	7.1
Tuberculosis	1.7
Measles	1.1
Scarlet fever	.75
Diphtheria	.46
Typhoid fever	.14

The authors give an interesting table which shows the relative fatality between army and civilian life, which follows:

Pneumonia is 12 times greater in the Army.

Meningitis is 45 times greater in the Army.

Measles is 19 times greater in the Army.

Scarlet fever is 6 times greater in the Army.

Diphtheria is 2 times greater in the Army.

Tuberculosis is 13 times greater in civil life.

Pneumonia and *meningitis* are the greatest causes of death, but they are not the greatest causes of rendering the troops ineffective. Measles incapacitated the largest number of all the diseases and was responsible for 7.3 per cent. ineffectives; venereal disease for 5.8 per cent., while colds, influenza, bronchitis and mumps all had a very considerable share. These figures do not take into account the influenza epidemic.

The different camps have shown wide variations in morbidity and mortality from pneumonia. The type of the organism causing the disease probably has a great deal to do with it, and the pneumonias due to the *Streptococcus hemolyticus*, which may cause both lobar and bronchopneumonia, are perhaps the most fatal forms, and this is also very frequently complicated with empyema. It was shown most convincingly that men from rural communities are more susceptible than those of urban life, and it has been noted before that the Southern soldier is much more susceptible than the Northern one, and this bears out the experiences of the Civil War. The crowding together plays a large part in the incidence of the respiratory infections, the droplet infection, caused by sneezing, coughing or even talking, taking place both in and out of doors. In the assembly halls the distance from the nose of one man and that of the man in front or behind him is 26 inches and to right or left 16 inches, so that with one-half the men coughing one can get some idea of the possibilities of infection. The protection of the men from the diseases may be accomplished to some extent by placing the

sick in cubicles, the prompt disinfection of sputum and the wearing of masks. These methods can be used only in the hospitals. Whether vaccination will or will not succeed is yet to be settled, but at Camp Upton about 12,000 out of a division of 30,000 were vaccinated against pneumonia, and during the next two months in which the troops were under observation the value of this seemed to be demonstrated. It will be necessary, however, to wait for further reports before drawing any definite conclusions.

In regard to *scarlet fever*, there was a very curious distribution among the camps. It was most prevalent at Camp Pike, Little Rock, Arkansas; and next in frequency at Camp Lewis, American Lake, Washington; Camp Kearny, Linda Vista, California; Camp Sherman, Chillicothe, Ohio; Camp Dodge, Des Moines, Iowa; and Camp Grant, Rockford, Illinois. The rate for Camp Pike was nearly twice that of the second camp in the table. With the exception of Camp Pike, the Southern camps have been free from the disease, and the greatest number of cases have been in those in which the troops came from the middle or far West.

Typhoid fever has practically disappeared. In twelve of the camps there was not a single case of typhoid or paratyphoid. In only three camps the disease appeared to any extent, and in all of these there were very few cases. This, of course, is due to the thoroughness with which the troops were vaccinated.

Another disease which has caused a certain amount of difficulty was *epidemic bronchitis*, which occurred at all the camps, apparently due to various organisms, and of which the reports are not very complete. Influenza, which has occurred at all the camps, and which is considered under the heading of that disease, became prevalent in Camp Ogleshorpe about March 18, 1918, and assumed endemic proportions. There were wide variations in the rates at different camps, and the various diseases and certain influences seemed to go on to all camps and certain others only on a certain group of camps. The prevalence of a disease may be attributed to one or more of the following causes:

1. Weakening of the resistance of the soldier due to:
 - (a) Exposure to severe weather.
 - (b) Insufficient clothing.
 - (c) Inadequate housing, lack of heat.
 - (d) Fatigue.
2. Unusual facilities for the transmission of the infective agent by:
 - (a) Close contact with carrier cases.
 - (b) Undetected cases among new recruits.
 - (c) Importation of mildly sick men and carriers from other camps.
 - (d) Association with civilian community.
 - (e) Overcrowded quarters.
 - (f) Inadequate hospital care of patients.
 - (g) Unsanitary conditions in general.
3. Natural susceptibility to disease:
 - (a) Racial influence.
 - (b) Effect of rural life.
 - (c) Climatic influence.

The War and Public Health. One of the great benefits that is going to grow out of the present campaign is a marked effect for good on the public health management in the United States. Before the present time, with a certain number of notable exceptions, the health administration of the various communities has been carried out by men either only partly trained or not trained at all in public health work, and in many cases by doctors overburdened with private practice. The unfortunate mingling of politics and public health has contributed further to rendering the prevention of disease a rather unsatisfactory process, especially when we consider what we actually know about the subject and what might be accomplished if proper methods were used. I think it was Rucker who remarked in one of his talks that our present-day municipal health departments should be called "disease departments," as they rarely took any cognizance of a disease until it had actually put in its appearance. The function of a public health officer is primarily to prevent disease. What frequently happens is that he sits at his desk and tabulates a number of cases and writes a number of lists and lets it go at that.

The Public Health Service of the United States has steadily increased in efficiency and power and has planned a program which meets the urgent national needs which they have outlined in the *Public Health Reports* (September 27, 1918, p. 1627). Before considering briefly what they purpose doing with regard to infectious diseases, I should like to call attention to the fact that when the present War is over there will be available for the civil population a large number of well-trained health officers—men who have acquired a special knowledge in the preventive work being done in the Army. This, together with the graduates of the School for Public Health in Baltimore, ought to make a very decided impression for the better on the health of all communities favored by their presence.

The measures outlined as a war program of the Public Health Service are intended especially for extra-cantonment areas and war industrial centers and are divided into seventeen different branches of activity. These include the safeguarding of the water and milk supplies, a very much talked of and very much needed reform in most American communities, and also a proper disposal of sewage. Diseases from improper sewage, such as typhoid fever, dysentery, diarrhea and hookworm, cause over 60,000 deaths annually in the United States, and this represents an enormous morbidity which ought to be lowered if the people can be sufficiently educated in this direction. Typhoid fever, malaria, venereal diseases, hookworm disease, tuberculosis and pellagra are each to be made the subject of a special campaign. The other special departments of endeavor deal more or less directly with the infectious diseases, and are to be industrial medicine with the proper medical and surgical supervision of employees, with reform in sanitation and industrial hygiene, railway sanitation, rural and municipal sanitation, and prevention of the diseases of infancy and childhood. In addition to these things, health standards are to be reported as well as health education, and naturally enough, the program includes reports on the prevalence of disease and death.

Lipovaccines. Whitmore, Fennel and Peterson² have an article on this subject which has received comparatively little attention in this country. They believe that the lipovaccines offer possibilities in the prophylaxis of a number of infectious diseases that have heretofore been lacking. They also call attention to the fact that the use of other vehicles than normal salt solution for vaccine work has been neglected until recently, and this is curious, since oil has become available for subcutaneous and intramuscular injections. Vaccines have been used in the form of ointments for external use, and Zeuner used soap solutions in making a tuberculin, and Whitmore similar preparations with the leprosy bacillus; but these preparations were made with a view of complete solution of the bacillus and not an alteration in the rate of absorption. In 1916, Le Moignic and Pinoy³ noted the possibilities that presented themselves in lipovaccines for use in prophylaxis. They first used a mixture of petrolatum and lanolin, but later substituted vegetable oils. Achard and Foix⁴ made similar observations, using olive oil, and they noted that if too high temperature was used for sterilization the oil seemed to cause abscess formation. The advantages credited to oil vaccines consist in a diminution of both local and systemic reactions, the possibility of giving sufficient vaccine at a single injection to properly immunize an individual; the persistence in the individual of a focus from which the immunization proceeds over a period of several months, with a resulting lengthening of the period of immunity; the actual detoxicating effects of certain lipoids that can be incorporated in the vaccine; and, lastly, the prevention of autolysis and deterioration of the vaccine.

The possibility of giving in one injection an immunizing dose saves a great deal of labor and a great deal of time, especially when one considers military service or the immunizing of large numbers of people at one time. The authors quoted have prepared the following vaccines: Typhoid-paratyphoid (A and B), pneumococcus (Types I, II and III), meningococcus (Types 1, 10, 30 and 60), dysentery (Shiga, Flexner and Y). The preparation employed tentatively is described as follows:

"Bacteria are grown for about twenty hours in large Petri dishes on mediums made up essentially as suggested by Vedder—that is, a meat infusion, soluble starch agar (3 per cent. agar) enriched with hemolyzed rabbits' blood. While it would be possible to use broth cultures for the growth of the organisms, we rather believe that a better immunizing product is obtained on agar. The growth is scraped from the smooth, firm surface by means of a small rubber squeegee and transferred to a small Petri dish. The bacterial mass or paste is next dried at 53° C. in an oven in which a current of sterile dry air passes over the opened dishes; the drying seldom requires more than forty-five minutes, depending, however, on the thickness to which the bacterial mass has been spread. After thorough drying the bacteria remain in the form of fine, glistening, brittle scales, which are readily removed by any sharp

² Journal of the American Medical Association, February 16, 1918, p. 427.

³ Compt. rend. Soc. de biol., 1916, lxxix, 201, 352.

⁴ Ibid., lxxix, 209.

instrument. The dry weight of the organism per thousand million being known (a large number of these determinations are at present made by Hersfeld in this laboratory), the bacteria are weighed under sterile precautions and ground in a ball mill for at least twenty-four hours. We add a few cubic centimeters of chloroform-ether to the grinding mass at the beginning of the process to ensure the final killing of any organism still viable at that time.

A second method that we have used in some preparations has been to grow the organisms in Kolle flasks, wash off the growth with a small amount of distilled water, freeze the latter and dry the frozen bacterial mass *in vacuo*. Both methods give excellent results, although for the production of large quantities of vaccine the first method described seems more expedient.

After thorough grinding, the admixture of the lipoids and oils is made as follows: "Sterile anhydrous lanolin, in an amount sufficient for the percentage desired in the final mixture (we have employed 10 per cent.), is gently warmed, and one-half volume of oil (olive oil or oil of sweet almonds) added to the lanolin, the whole being poured into the ball mill. The viscid mass is mixed for another six to eight hours, at the end of which time increasing amounts of oil are added at intervals until the volume has been brought to the quantity desired."

The oils used should be non-irritating and of slow absorbability and must not be too viscid for injection, and should stand complete sterilization without alteration. Anyone considering working with oil vaccines should consult the work of Mills.⁵ The oils usually used are vegetable oils, such as olive, sweet almond and poppy. The mineral oils were first used by the French observers, but have been discarded.

The method of administering the oil vaccines is important, as it renders the needles and glassware slippery. The skin should be sterilized with iodine and the vaccine warmed to body temperature, which facilitates its flow. A sufficiently large bore needle, kept properly sharpened, should be used, and the oil should be drawn into the syringe with the needle detached. The greatest care should be observed to prevent intravenous injection, owing to the danger of fat embolism. When the needle is withdrawn, a small iodine swab should be held against the puncture until the back flow of the oil ceases.

The pneumococcus vaccine, as used at Camp Upton, is noted elsewhere and is being supplied by the Army Medical School at certain places. It is to be noted that this vaccine is intended for prophylaxis and not for those sick, and it is not advised for persons suffering with acute colds or fever.

The Control of Respiratory Infections in Military Camps. Two curious things have come out of the study of the diseases at army camps, the first, infrequency of gastro-intestinal infections, and secondly, the remarkable number of respiratory infections, particularly of the streptococcus group. Capps⁶ has made a study of this subject and believes that the disappearance of typhoid and paratyphoid is due to the general

⁵ Archives of Internal Medicine, May, 1911, p. 694.

⁶ Journal of the American Medical Association, August 10, 1918, p. 448.

use of inoculation, and that dysentery is probably prevented by the safeguarding of the drinking water. It is indeed fortunate that we profited by the lessons so painfully learned in the Spanish-American war. Up to the present time methods of preventing respiratory infections have not been so successful. Owing to the fact that it has been shown in various epidemics of sore-throat that the streptococcus is distributed in milk or ice-cream, it is suggested that all milk and cream produced should be pasteurized under the direct supervision of the camp authorities; the most satisfactory method being to build and equip a pasteurizing plant in the camp proper. The ice-cream used at the camp could be manufactured in the same plant. It is also possible that a lowering of the incidence of scarlet fever and diphtheria might occur.

The natural, and perhaps necessary, crowding in barracks, at mess tables, and in recreation rooms, of course, does much to facilitate the rapid spread of respiratory infections. Various methods of preventing the spread of diseases are suggested, such as the segregation of newly arrived troops for three weeks in detention camps, and the avoidance of droplet infection by increasing the space between the beds in the barracks, or placing the head of one soldier opposite the feet of his neighbor. It has also been suggested that tent flaps be stretched between the beds, and a curtain suspended down the middle of the mess table has also proved of service. The most effective method of securing isolation of the individual, according to Capps, is by means of a mask of gauze in the shape of a rectangle measuring five by seven inches. Because of variations in the weight and weave of commercial gauze, it is important to fix a standard texture, and some observations are being undertaken to determine just what is necessary in this line. This is the same mask that has been employed by surgeons as a filter for the air in operating rooms, and it is used in preventing various contagious diseases, such as diphtheria, meningitis and pneumonia, and has been commented on by Weaver.⁷

Capps is perhaps the first to use masks in large quantity and the work begun at Camp Grant in the latter part of January, 1918, was so successful that it was instituted in most of the medical wards early in February, and was carried out at the regimental infirmary in the receiving ambulances and in the wards. The directions observed were as follows:

1. At the regimental infirmary every patient with contagious disease is masked immediately after the diagnosis is made.

2. Every patient on entering the ambulance, whether infected or clean, is masked. Each ambulance carries a box of clean masks, which is replenished at the receiving ward.

3. At the receiving office the ambulance patients continue to wear their masks. Other patients who walk to the hospital for minor ailments are masked at the door by a non-commissioned officer. All retain the mask in place during the examination and on the trip to the ward and remove it only when they are in the ward cubicles. Since the initiation of this practice the occurrence of cross-infection from contact in ambu-

⁷ Journal of the American Medical Association, January 12, 1918, p. 76.

lance and receiving ward, previously quite frequent, has been rarely observed.

4. In all wards for contagious and respiratory diseases (this includes nearly all the medical wards) the mask is worn by patients as well as by physicians, nurses, ward men and visitors. As long as the patient remains within the shelter of the cubicle he need not wear the mask, but he puts it on whenever he leaves the cubicle for any reason. Patients must either have their meals served in bed, or, while masked, procure their tray of food and carry it to the cubicle. All eating utensils are sterilized for each meal.

Smoking is absolutely prohibited, as it necessitates the removal of the mask.

In view of the danger of transmission from the wash bowls, the plugs are removed, so that only running water is available for washing the face and teeth. Only one person at a time is allowed in the wash room, as the mask is necessarily removed therein. On the other hand, there is no objection to several persons occupying the latrine at the same time. The latrine is kept separated from the wash room in the double wards by locking the communicating door in the single wards and by hanging up sheets between closets and wash basins. To enforce the wash room regulations a guard, who is usually a convalescent patient, sits outside the door.

Much depends on stimulating a lively interest in the scheme on the part of nurses and ward men. The ward surgeon very easily wins the coöperation of the patients themselves by frequent short talks, explaining the purpose of the masks and pointing out their similarity to the gas masks."

The cubicle and mask isolation was in continuous use from February 1 to June 1, 1918, and in twenty wards exposed to scarlet fever as a secondary infection only one subsequent case developed during the week of quarantine. In eight wards exposed to measles as a secondary infection not one case developed during the period of quarantine, so that the method seems to be 95 per cent. in exposure to scarlet fever and 100 per cent. in exposure to measles. It might be noted that when a scarlet fever case broke out the ward was quarantined for a week, and when measles broke out, for two weeks.

According to McLester, similar results were obtained at Camp Sheridan. At one time almost every patient in a measles ward had bronchitis or coryza, and bronchopneumonia was developing rapidly. Removing the cases of bronchopneumonia as soon as the diagnosis was made did not stop the spread of the disease, but it was checked by putting the beds in cubicles, and subsequently an epidemic of so-called grippe was checked by the use of the cubicle and mask method.

The Protective Qualities of the Gauze Face Mask. The advent of the influenza epidemic has made the subject of the value of the face mask one of considerable interest. Among the contributions are those of Capps, alluded to elsewhere, and of Weaver, who, at the Durand Hospital in Chicago, showed its value in protecting attendants on infectious disease cases both from contracting them and from becoming carriers.

Haller and Colwell⁸ have carried out some interesting observations dealing with the different kinds of gauze. Some were found obviously too thin, such as those with only three layers, while those with eight layers were very hard to breathe through and very warm and uncomfortable. They found a great variation in the size of the mask and also in the size of the same mask before and after washing. The various kinds of gauze were known by names, and also by the number of strands to the warp and woof. Fine gauze runs twenty-eight strands to the warp and twenty-four strands to the woof, and other grades twenty to fourteen. As a result of their experiments with a pneumococcus carrier of Type IV, they express the belief that gauze of the quality of Lakeside (24 by 20) or L and L (28 by 24) should be used in four layers, and Bauer and Black (32 by 26) in three layers provided all persons are masked, patients as well as attendants. They think the mask should be 8 inches in length and 5 in width, with edges turned in and stitched. Two braids should be used, each one a yard long and sewed along the upper and lower borders of the mask, so as to leave a free end fourteen inches long; and the mask should be marked on the face side by a black thread tied into the gauze. A small amount of work done with Turkish toweling showed that one layer was a highly effective droplet filter and had the advantage of being lighter to wear. These masks are more expensive, and the question of wear was not settled.

Doust and Lyon⁹ have made a study to determine the limits of projection of droplets from the mouth during ordinary speech, loud speech and coughing. Their method was to rinse the mouth and gargle the throat with a suspension of *Bacillus prodigiosus* in 0.85 per cent. sodium chloride solution. The observer then entered the room and seated himself in a chair facing down the length of a table. In line with the observer's mouth, agar plates were exposed from one to six feet distant, except in some of the coughing experiments, when plates were placed up to a distance of ten feet. The observer then talked in an ordinary tone for five minutes or in a loud tone for five minutes, or coughed as much as possible for five minutes. They determined that during ordinary or loud speech, infected material from the mouth is rarely projected to a distance of four feet or less. A four-foot danger zone exists about the patient under these conditions. During coughing, however, the infected material may be projected at least ten feet, so that the coughing danger zone around a coughing patient has a minimum radius of ten feet. Their experiments with the gauze mask led to the conclusion that masks of coarse or medium gauze of from two to ten layers do not prevent the projection of infected material from the mouth during coughing, and they believe that such gauze masks are worthless in preventing the dissemination of respiratory infections; but this statement is evidently meant to apply to masks used on patients. They found, however, that a three-layer buttercloth mask, which is considered finer than gauze, is efficient in preventing the projection of infectious material from the mouth

⁸ Journal of the American Medical Association, October 12, 1918, p. 1213.

⁹ Ibid., p. 1216.

during speaking or coughing. They suggest that masks of this material be used in connection with respiratory diseases.

Hoyne¹⁰ believes that the management of any contagious disease hospital which adopts the compulsory wearing of masks for its employees is simply making an admission of inadequacy on the part of its nursing and medical staff. He believes that the face mask has its definite value, as outlined by Weaver, and that it should also be used before attempting work of any character about the nose or mouth of a patient. He also believes that it is necessary to supply clean masks at sufficiently short intervals, and the wearing of a face mask may give a feeling of mental security, so that the ordinary care regarding the spreading or acquiring of infection might be neglected. We can feel confident, however, that the real value of the mask and a more complete knowledge of its technic will be in our possession before another year has passed.

Infection of the Upper Respiratory Tract and Acidosis. Gardner¹¹ made a study of certain cases of infection that occurred during the winter of 1915 and 1916 in Boston and its vicinity. These cases could be divided into two classes: (1) Uncommonly severe and frequent nasopharyngeal infections in adults, which in some cases proved to be of bacillus influenza origin, and (2) infections in children in whom gastro-intestinal symptoms had been so prominent as to divert attention entirely from the respiratory tract. Three of this latter group came to autopsy, and all showed an infection of the *Staphylococcus pyogenes aureus*, and in one case, in addition, there was a septicemia. All showed an acute laryngitis, bronchopneumonia and various toxic reactions appearing in the lymph-adenoid tissue, in the walls of the bloodvessels and changes in the renal epithelium, and in one instance in the adrenal cortex. These patients presented symptoms of a severe toxemia, and each of the lesions was associated with a large amount of fat formation, and a large amount of fat was present as globules, free in the blood serum.

It seems plausible to believe that some relation exists between these disturbances of fat metabolism and acetonuria. These observations are particularly striking, inasmuch as they call attention to the careful study of the lungs and larynx in cases of otherwise unexplained persistent vomiting. I recently saw a fatal case of recurrent vomiting in which there was a partial consolidation of the lower lobe of the right lung which could not be made out by ordinary methods, but which was easily visible in the x-rays. This had existed long enough to cause clubbing of the fingers and toes, and was doubtless the underlying cause of the recurrent attacks of severe vomiting.

Sensitized Vaccines in the Prophylaxis and Treatment of Infections. Cecil¹² has an article dealing with this subject. Sensitized vaccines are those in which a suspension of bacteria has been treated with an homologous serum and were, perhaps, first employed in 1902 by Besredka, although Shiga had used mixtures of serum and vaccine during the previous year for immunizing against plague and dysentery. Besredka

¹⁰ Illinois Medical Journal, September, 1918.

¹¹ American Journal of the Medical Sciences, March, 1918, p. 380.

¹² Ibid., June, 1918, p. 781.

ascertained that both plague and typhoid bacilli which had been killed by heat and sensitized were less toxic, both subcutaneously and intraperitoneally, than non-sensitized bacilli, and that the injections of the sensitized organisms were followed by an almost immediate increase in the immunity without the so-called negative phase which intervenes after the use of the non-sensitized bacteria. Subsequently, in connection with Metchnikoff, this same investigator found that chimpanzees could not be protected against typhoid fever with any degree of certainty either by sensitized or non-sensitized killed typhoid bacilli, but that sensitized living bacilli caused a very high degree of immunity. In 1913, Besredka reported his observation on the Island of Braqueville, in which about one-half of the 930 inhabitants were treated with a living sensitized vaccine, the other half serving as controls. The following year four of the controls developed typhoid fever, while all of those vaccinated remained free from the disease. Subsequently, other observers have made somewhat similar reports. The same method has been applied to other bacteria, streptococci, gonococci, and pneumococci being most frequently used, and von Behring, in 1914, introduced a method of active immunization against diphtheria by using a diphtheria toxin neutralized with antitoxin.

Cecil's experience is limited to typhoid, gonococcus, streptococcus, and *Staphylococcus aureus* infections. As a result of his experiences, he concludes that the sensitized typhoid vaccine produced a somewhat milder reaction than the ordinary typhoid vaccine and doubtless gives just as high an immunity, but at the present time there is not sufficient evidence of its superiority to justify its substitution. In the other infections it was found that the sensitized vaccines were, as a rule, no better than the ordinary vaccines, but it was also true that there were a few instances of recovery which followed the use of the sensitized vaccines after the ordinary ones had failed. This may have been due, however, to the fact that larger doses could be employed without untoward symptoms. The chief objection to the sensitized vaccines is the increased labor and time needed in their production, and at the present time Cecil believes it desirable to limit their use to the treatment of infection in which there is hypersensitiveness to ordinary vaccines or in which the latter has proved inefficacious.

Acute Mastoiditis as a Complication of Infectious Diseases. Among the numerous complications due to *Streptococcus hemolyticus* that have been met with in the training camps is acute mastoiditis. Lathrope¹³ has made a study of 123 cases in the Base Hospital at Camp Shelby, Mississippi. This particular camp seemed to have suffered from what might be called an epidemic of this complication, in other words there was a general streptococcus infection at camp, and among the prominent exhibitions of this was acute mastoiditis. In the cases studied by Lathrope the organism most frequently isolated was either the *Streptococcus viridans* or an organism closely allied to it. In many of the cases the streptococcus infection was preceded by an attack of measles, which seemed to prepare the ground for the secondary infection.

¹³ Journal of the American Medical Association, August 10, 1918, p. 451.

The Relation of Streptococci to Bovine Mastitis and Septic Sore-throat.

As early as 1880, an epidemic of sore-throat having a relation to the milk supply was reported at Rugby, England. In the United States, an epidemic having a very definite relation to the milk supply was reported in Boston in 1911, and the following year epidemics occurred in Chicago, Baltimore and Boston, and subsequently in several other places. In all these places the streptococci were undoubtedly the cause of the disease, and those isolated resembled the *Streptococcus pyogenes*, with some slight differences. For the most part, the organisms isolated were definitely hemolytic.

Davis¹⁴ has isolated similar organisms from bovine mastitis and has made a study of 98 strains, of which 24 were of human origin. None of these organisms from human beings resisted 60° C. (140° F.) for thirty minutes, whereas twenty strains of hemolytic streptococci of milk origin, and having practically no virulence, resisted 68.3° C. (155° F.) for thirty minutes, and he states that he knows of no evidence to indicate that strains of streptococci pathogenic to man can resist the usual temperature for pasteurization (145° F.) for thirty minutes. It is true, however, that what constitutes efficient pasteurization for streptococci is a subject which requires further study, and the statement made that pathogenic streptococci are killed at relatively low temperatures at short exposures is, in many instances, not true. Ayres and Johnson, in a study of this subject, have found that the thermal death of typical streptococci varies considerably, and they found that one of twenty-two strains studied by them resisted heating at 62.8° C. (145° F.) for thirty minutes, which shows that milk that is ordinarily pasteurized might, under certain conditions, contain organisms that are pathogenic for man.

Recent Aspects of Streptococcus Infection. Anyone interested in this subject will do well to consult the article of Gay¹⁵ who has made an extensive review of it and given a rather complete bibliography for the past few years. Lack of space prevents any further reference to this interesting resumé.

Carbon Tetrachloride Vapor as a Delousing Agent. Foster¹⁶ has made a study on the subject of using carbon tetrachloride vapor for destroying body lice on clothing. The most effective methods for delousing are the use of dry and moist heat and hydrocyanic gas, but, unfortunately, all of these methods require more or less complicated apparatus which may not be available for use. In searching for some practical method for destroying lice and which could be applied with some simple apparatus without injuring woolen clothing, Foster experimented with carbon tetrachloride which is a heavy, colorless fluid with a slightly fruity odor, and is extensively used in fire extinguishers, as a solvent for many substances in the arts, and also as the chief constituent of certain proprietary cleansing fluids on account of its power to dissolve fats. Its vapor is heavy and instantly extinguishes combustion. As an insecticide, it has been little used, but it appears to be of considerable

¹⁴ American Journal of Public Health, January, 1918, p. 40.

¹⁵ Journal of Laboratory and Clinical Medicine, St. Louis, September, 1918, p. 721.

¹⁶ Public Health Reports, October 25, 1918, xxxiii, p. 1823.

value. Foster found that by using a 10-gallon tin can, such as is used for shipping disinfectants, that is, a can 12 inches in diameter and 19 inches high, the clothing of a United States Army private could be disinfected with 25 c.c. of carbon tetrachloride. The clothes were packed into the bottom and several layers of filter paper put on top of this over which the carbon tetrachloride was poured. The top of the can was covered with several thicknesses of toweling and a loose cover placed over it, the idea being to protect the can from drafts, but not to seal it hermetically so as to permit some of the air to escape from the top when it was displaced by the heavy vapor at the bottom. The lice placed in the can experimentally were found dead at the end of two hours, but it was also found that one and a half hours was not sufficiently long. The ova of the lice are not killed by 30.5 c.c. of the carbon tetrachloride to a cubic foot of space after two hours' exposure. Further experiments will be necessary to determine what exposure is necessary to kill them.

Carbon tetrachloride is not absolutely without danger, although the fact that it is used for cleaning very generally without accident shows that it can be handled with reasonable safety. There have, however, been several deaths reported among hair dressers and their subjects when this substance was used for cleaning the scalp. This was probably due to inhaling the fumes in a concentrated form.

The Bacteremias in the Agonal Period. This is a subject of very great importance in relation to antemortem and postmortem bacteriologic findings and a better knowledge of the subject will lead to fewer mistakes in interpreting bacteriological findings in the agonal period or after death. Comparatively few studies have been made on this subject, although there have been a number of notable contributions, including those of Fredette, and Flexner's work on terminal infections will also be remembered in this connection. Richey and Goehring¹⁷ have made an extensive study of this subject, using blood cultures taken from arm veins immediately after death. The technic of this procedure is relatively simple, and this method may be used when autopsy is not permitted. The results so obtained are evidently much more reliable as indicative of previous antemortem infection than are cultures made at autopsy. In a study of 206 cases, about one-third gave positive cultures. Where studies were also made on antemortem blood cultures, the results were usually the same as those obtained by immediate postmortem cultures, but an invasion of the blood stream may occur in the interval between taking the antemortem and the postmortem cultures, and of this they give several striking examples. Cultures from the heart blood at autopsy gave positive results more frequently than those taken from the arm vein immediately after death. The authors found that when persons died of chronic debilitating diseases, bacterial invasion was more frequent than when the death was traumatic. In the former cases, in 55 cultures, 36 gave positive results, whereas after traumatic deaths there was only one positive culture in 36 observations. The various cocci are the most frequent invaders of the blood stream, and

¹⁷ Journal of Medical Research, July, 1918, xxxviii, p. 421.

those of the *Streptococcus-pneumococcus* group are held to be the most important, whereas in cultures of hearts' blood at autopsy there is a relative increase in the ratio of bacilli to cocci. In 50 per cent. of the cases that had been diagnosed as pneumonia during life, the pneumococci were isolated immediately after death. There is a curious low percentage of positive cultures, but Richey and Goehring believe that this may be explained partly by the non-selection of the cases and to the short interval after death at which the cultures were taken. If one excludes typhoid fever, the number of positive cultures of pathogenic organisms made in disease conditions in general is strikingly small, in the authors' experience 27.3 per cent., these figures being in the laboratory in which typhoid was rarely met with.

Anthrax at Camp Hancock, Georgia. This disease is so rare in this country that unless one bears in mind the appearance of the anthrax pustule the diagnosis may be overlooked. The incubation period varies from one to five days, and the disease starts as a small red papule with sometimes itching and burning. In from twelve to twenty-four hours a vesicle forms and this is surrounded by a red areola and edema. The vesicle breaks in a few hours, leaving an ulcer from which there is a small amount of clear discharge. Within the next day, the ulcer becomes blackened and there are numerous vesicles along its edge. A point of considerable value in diagnosis is that the edema and redness are generally out of all proportion to the size of the lesion. The lymph nodes of the affected area are usually swollen, and the patient suffers from high temperature, cyanosis, often vomiting and diarrhea, and usually death.

Ludy and Rice¹⁸ have reported 3 cases that occurred at Camp Hancock, Georgia. They call attention to the points in differential diagnosis somewhat as I have outlined above, and they suggest the following therapeutic procedure:

1. The tissues about the lesion should be infiltrated with from 30 to 50 c.c. of anti-anthrax serum, a large needle and Luer syringe being used.
2. The lesion should be dissected, a nose cautery being used, and an effort made to remain at least one-half inch from its border.
3. Seventy-five c.c. of anti-anthrax serum with 50 c.c. of physiological sodium chloride solution should be given intravenously.
4. Seventy-five c.c. of anti-anthrax serum should be given intramuscularly.
5. The wound should be dressed once in twenty-four hours with a solution of phenol (carbolic acid), 3 parts; camphor, 7 parts; glycerine, 40 parts; alcohol, 180 parts.
6. The serum therapy should be repeated every eight hours, according as circumstances may require.

Balantidium Coli Infection. Young and Walker¹⁹ have reported a case of this infection from Oklahoma. This parasite is one of the ciliated infusoria, the body of which is nearly oval, one side being somewhat longer than the other, and it measures from 0.06 to 0.01 mm. in length

¹⁸ Journal of the American Medical Association, October 5, 1918, p. 1133.

¹⁹ Ibid., Feb. 23, 1918, p. 507.

and from 0.05 to 0.07 mm. in breadth. The organism is encased in a thick ectosarc thickly set with cilia by which it is enabled to move forward rapidly with a rotary motion. This organism is also known by the name of the *Paramecium coli*. This form of infection was first reported by Malmsten and Loven in 1857, and the authors quoted state that about 150 cases have found their way into the literature. Strong, in 1901 (Bulletin 26, Bureau of Government Laboratories), made a careful search of the literature, and found at that time 117 cases. The organism causes hyperplasia of the lymph tissues and plasma cells, and an increase in the eosinophiles. The infection is accompanied with shallow ulcers in the intestine, supposed to be due to the secondary invasion of bacteria. The pig is the normal host, and the infection is doubtless through the use of infected food or water.

Young and Walker's case was in a white man, aged sixty years, who was born in Kansas, where he lived for thirty-eight years, when he moved to Oklahoma, where he had lived ever since. He had not been confined to bed for forty years. He was admitted to the hospital with severe abdominal pain, diarrhea and tenesmus. He had light yellow, liquid stools containing much mucus and blood, and numerous organisms. The patient was treated with enemas of 15 grains of quinine in one quart of water which was given as frequently as every fourth hour, and then decreased in frequency until the organisms had disappeared, which happened in a couple of weeks' time, after which he was placed on three drops of Lugol's solution three times a day for two months. Before the report the patient had uncomfortable, but not painful, sensations in the abdomen, and the stools showed an occasional organism. He had gained approximately twenty-nine pounds, and was in excellent health.

Chorea. THE BACTERIOLOGY OF CHOREA. The fact that chorea is frequently associated with acute infections, especially tonsillitis, rheumatic fever and endocarditis, has been known for a very long time, and in consequence there have been numerous efforts to associate the disease with some form of bacteria. As early as 1891, Pianese isolated a bacillus from a postmortem blood culture, while Dana, Westphall, Wassermann and Malkoff succeeded in growing a diplococcus from the nervous tissues, and similar organisms were isolated by Poynton and Payne in 1905. Their cases were chorea in association with acute rheumatic fever and the observations were postmortem. *Staphylococcus albus* was isolated by Donath in 1910, and Richards isolated a streptococcus. Blood cultures made during life by various observers have shown diplococci, *Staphylococcus albus*, *Staphylococcus aureus* and diphtheroid bacilli. Using large material in Bellevue Hospital in New York, La Fetra, in 1915, was able to obtain positive results in only 2 cases, both of which showed the *Streptococcus viridans*; Bartley, and also Koplik, were unable to find any organisms whatever. The observations on postmortem material from the central nervous system, of course, are valueless, and there have been but few studies of the cerebrospinal fluid in chorea during life. In a single instance Donath found the *Staphylococcus aureus*, whereas Collins, Passini, Morse and Floyd were not able

to obtain any growth whatever. There are some observations dealing with the use of various organisms in animals, and various observers have reported one or more instances of noticing tremors and twitchings after using organisms obtained from various human tissues.

Quigly²⁰ has collected the above observations and given his own results. In 21 patients, 10 gave positive results from blood cultures, 9 showing a small, slightly elongated coccus arranged in pairs and short chains. The other part of the blood culture gave a Gram-positive short diphtheroid organism. The cerebrospinal fluid of 21 patients gave 13 positive results. Eight of the organisms isolated resembled very closely the organism found in the blood. The other 5 were somewhat similar, but the growths were more luxuriant in some slight particulars. Quigley found there is nothing particularly characteristic or peculiar in the spinal fluid of chorea; the average cell count was three to six cells and there was no constant relation to the severity of the chorea and the cell count and the spinal fluid. Globulin was not present, and all the fluids that were examined decolorized Fehling's solution and produced a fine brick-red precipitate.

These results differ from observations made by others, particularly French observers, who generally reported a lymphocytosis in the spinal fluid. Observations on animals with the organism were inconclusive. The organism found resembles that generally isolated in rheumatic fever and endocarditis.

Diphtheria. ACTIVE IMMUNIZATION OF INFANTS AGAINST DIPHTHERIA. Zingher²¹ calls attention to the need of some practical efficient method of active immunization to protect the child in an adult population against this disease. Most of the cases and most of the deaths occur from one to five years of age, so that the method must be applied early in life. He gives some interesting statistics on the mortality and morbidity of the disease which emphasize the necessity for some better method of combating it than that which we have previously had. During the past five years, 1913 to 1917 inclusive, there has been a yearly average of 14,613 cases, with 1258 deaths, in New York City. In 1910, in the registration area of the United States, there were 11,512 deaths, which was nearly double the number caused by either measles or scarlet fever. In a study of these and other more extensive figures that he gives, he points out that in spite of the use of small prophylactic doses of antitoxin the total number of cases has not been reduced to any extent, nor have the present methods of isolating and treating carriers accomplished much when viewed on a large scale. There have been a number of recent investigations on the subject of natural and active immunity, and the Schick test furnishes a valuable clinical test for determining the immunity.

From a prolonged experience covering a number of years, Zingher has drawn some important conclusions: (1) That the negative Schick reaction, when done with proper technic and a suitable toxin, gives definite information as to the presence of immunity to diphtheria. Not

²⁰ Journal of Infectious Diseases, 1918, xxii, p. 198.

²¹ American Journal of Diseases of Children, August, 1918, p. 83.

only is this true, but (2) he states that a negative Schick test is of value in children over one and a half to two years of age in noting the development of a natural immunity which seems to be permanent. (3) In children below six to nine months of age the immunity, as shown by a negative Schick reaction, is only temporary and derived from the mother through the placental circulation. In breast-fed infants the immunity is derived through the breast milk, but all of these infants sooner or later become susceptible to the disease. If the mother has no immunity of her own, the child is susceptible at birth. If the mother is immune, the child becomes susceptible from six to nine months after birth, but a child may retain this maternal immunity even up to its eighteenth month. (4) An increasing proportion of children gradually develop a natural immunity and in adult life from 85 to 90 and even 95 per cent. have become immune.

Zingher therefore believes that by actively immunizing children under eighteen months and only those over eighteen months who give a positive Schick reaction, the entire child population could be rendered immune to the disease during the period of greatest susceptibility and greatest danger from death. By the use of diphtheria toxin-antitoxin mixtures, susceptible individuals may be lastingly immunized, or, at any rate, the immunity has persisted for three years, and in a small group for over four years. Zingher believes that the character of the immunity so produced may be either an active immunity similar to that following other forms of vaccination, or that it is the earlier development of the natural immunity that would have gradually developed in later years, or a combination of these two. This active immunity, which is produced by toxin-antitoxin injections, develops slowly, and is not suitable in controlling a sudden, acute outbreak of the disease. Under such circumstances it is recommended that a combination of active and passive immunization be made in all those giving a positive Schick reaction, and, after the end of four or five weeks, to retest the patient and to give three more doses of the toxin-antitoxin mixtures at weekly intervals in all children showing a positive reaction.

In young infants, the toxin-antitoxin reaction produces very little local or constitutional disturbance, and this fact makes the immunization in early life very desirable. In later life there may be rather severe local and constitutional symptoms consisting of redness, swelling and tenderness of the arms, and slight fever lasting a day or two. This is most liable to occur in those showing pseudoreactions, and is due to the action of the bacillus protein in the mixture. The toxin-antitoxin mixtures must be made in a laboratory and tested in the guinea-pig for its potency. It should be slightly toxic and should represent about 85 per cent. of an L+ for each unit of antitoxin, and should be supplied by municipal and State health departments free of charge.

Zingher believes that infants below twelve and, if possible, below eighteen months of age should be immunized with three doses, of 1.0 c.c. each of this mixture, and it should be given, if possible, at the time of the Schick test, irrespective of the result the infant may show at the time of immunization. The injections may be given either subcuta-

neously in the arm or below the angle of the scapula. The Schick test may be omitted, if desired, under eighteen months of age, as all those children should be immunized anyway, and it lessens the labor of the physician, although it offers interesting data where it is possible to apply it. This method should be used in all the larger groups of children, such as are seen in milk stations, day nurseries, and children's dispensaries and orphan asylums, and it is of particular value in those who are constantly exposed to infection, such as doctors, nurses, hospital orderlies and patients in contagious disease hospitals, but only those giving positive reactions need to be actively immunized.

Diphtheria. THE TREATMENT OF DIPHTHERIA CARRIERS. McCord, Friedländer and Walker²² have made some studies on the subject of diphtheria carriers at Camp Sherman, Ohio. As is well known, the ordinary methods of treating diphtheria carriers are not very satisfactory. Those ordinarily employed are spraying with the staphylococcus or other organisms, the use of desiccated diphtheria antitoxin by insufflation, the use of diphtheria endotoxin and numerous other materials, such as kaolin, jasmine oil, Dobell's solution, ferric chloride and other antiseptics, and astringents have been recommended and generally discarded, and some have even resorted to the removal of the tonsils to get rid of the bacilli in persistent cases. The authors referred to recommend that the diphtheria carriers be examined by throat specialists for the treatment of any ulcers in the tonsils or adenoids, and if these are badly involved they recommend their removal. They also used systematic treatment with chloramin-T (chlorazene). They used Dakin's solution of 0.25 per cent. administered as a gargle three or four times a day. In some instances throat specialists made the application, to be sure of reaching the far places of the nasopharynx. The gargling was followed by an oily spray of a dichloramin-T solution of 2 per cent. strength. They believe that by the use of this method the period over which the diphtheria carriers need to be treated is considerably decreased.

Amebic Dysentery. OIL OF CHENOPODIUM IN THE TREATMENT OF AMEBIC DYSENTERY. This disease is one which up until recently has been most unsatisfactory to treat, and numerous drugs of various kinds have been suggested, but lately these have given place to ipecac and subsequently to its active principle—emetine. The last-named presents some objections in that it occasionally causes toxic symptoms and even death has been attributed to it.

Barnes and Cort²³ have made some interesting observations in connection with the control and eradication of hookworm infection in Siam. In the earlier days, dysentery was considered as a contra-indication to the use of emetics. Owing to the great improvement in health of the persons treated, large numbers of sufferers from dysentery applied for relief and a number of these were treated with very favorable results. The methods of treatment varied. Some patients were given a preliminary dose of $\frac{1}{2}$ ounce of magnesium sulphate and two hours later a capsule of 1 c.c. of oil of chenopodium. The second dose was given one

²² Journal of the American Medical Association, July 27, 1918, p. 275.

²³ Ibid., August 3, 1918, p. 350.

hour later, and 1½ ounces of castor oil an hour after the second administration. In the more severe cases the saline was omitted and 2 c.c. of oil of chenopodium given, and 1½ ounces of the castor oil in a single dose. In some other cases the oil was emulsified with gum acacia and given by rectum. The anal mucosa must be protected by petrolatum and it is well to follow the injection by 2 ounces of inert oil. The body should be elevated and the injection given very slowly. The first dose should not exceed 8 ounces in a grown person. This should be retained as long as possible. In most of the cases there is marked improvement in the general condition, and the blood and mucus disappear from the stools on the second day. In some instances there was no improvement; in others it was only temporary. The simplicity of this method is apparent, and it deserves further studies. At least two or three weeks should elapse before repetition of the dose on account of the possibility of irritation of the kidneys.

THE TREATMENT OF AMEBIC DYSENTERY. Several years ago Brem and Zeiler²⁴ reported the successful use of ipecac by rectum and also through the appendix after appendicostomy. This method succeeded after other methods had failed. Lawson,²⁵ without being familiar with this work, had had some experiences along the same line; his method being to put 60 or even 120 grains of powdered ipecac into an ounce of water. This is kept hot for an hour, but not allowed to boil. After a cleansing enema, preferably with plain warm water, this whole preparation, without filtering, is given slowly and is to be retained as long as possible. When there is much pain or tenesmus, only part of it can be given. He reports 2 cases treated by this method alone which recovered, and urges it as a supplementary treatment when emetine is used subcutaneously.

Carulla and Borzone²⁶ have suggested the use of an infusion of pomegranate flowers and give their results in 3 cases in their preliminary report. All 3 cases had resisted emetine or other treatment. The treatment consisted of using an infusion two or three times a day, but after a few days less often. In all 3 cases the return to normal was rapid. The authors believe that they have made a contribution of value in the treatment of resistant cases of this disease.

Vaccination Against the Dysentery Bacillus. Olitsky²⁷ has made a study of this subject which has been a matter of considerable interest for a number of years. The first observations were made by Shiga in 1898, who injected himself subcutaneously with part of a killed agar slant culture of the organism of the type that bears his name. This was followed by a very intense local reaction, with formation of pus which required surgical treatment. Ten days later agglutinins were demonstrable in his blood. Kruse, also experimenting on himself, developed severe local reaction which persisted for a week, and agglutinins developed in his blood. From these, and other observations, it was clear

²⁴ New Orleans Medical and Surgical Journal, July, 1911.

²⁵ Journal of the American Medical Association, September 28, 1918, p. 1049.

²⁶ La Semana Medica, August 15, 1918, p. 215.

²⁷ Journal of Experimental Medicine, July, 1918, p. 69.

that simple suspensions of killed bacilli in salt solution were too toxic for ordinary use, and efforts were made to sensitize the antigen or to neutralize its toxicity by the addition of immune serum to the bacteria. Using this procedure, Shiga vaccinated 10,000 Japanese, with the production of a certain amount of immunity, inasmuch as the mortality was reduced. Unfortunately, the immunity lasted only three or four weeks. Subsequently, the Besredka method of sensitizing vaccines was employed by Vaillard and Dopter, who claimed good results, but Lüdke demonstrated that the sensitization, while it removes the toxicity of the organism, also destroys its antigenic function. Various other methods have been used, and Olitsky has suggested the use of suspensions in oil after the method introduced by Le Moignic and Pinoy. This permits a slow absorption of the bacilli with only a slight general local reaction, and it is possible to give at one time in a single dose a large number of the killed dysentery bacilli to develop a high degree of immunity. During the first day there is a slight erythematous area at the site of injection which is not especially painful. There may be a slight systemic reaction and some headache and chilliness. After twenty-four or sometimes forty-eight hours, an induration appears at the site of the injection and this varies from 2 to 4 cm. in diameter and remains unchanged for a few days and gradually disappears in from one to three weeks. From observations made on animals and a small number of tests on man, Olitsky believes that a single injection may produce a sufficient number of antibodies to afford protection, and this method may be of very definite use in immunizing human beings.

The Diphtheroid Organisms and Hodgkin's Disease. On a number of previous occasions I have referred to the work done upon this subject and also on the rather universal presence of diphtheroid organisms. The present-day tendency to believe that Hodgkin's disease is not due to diphtheroid organisms has been confirmed by Ebersson.²⁸ He has made a rather extensive study of these organisms with a view of renaming and reclassifying this group which at present is in a rather chaotic condition. He offers a tentative classification which, when grouped according to prominent biologic characters forms nine distinct groups. It will not be necessary to go into the differences that are of interest to laboratory workers only. His study of the diphtheroids associated with Hodgkin's disease shows that neither the source nor the cultural characters serve to distinguish these organisms from saprophytic diphtheroids and that complement-fixation tests seemed to show that this organism is not the cause of the disease.

The Treatment of Hookworm Infection. Darling, Barber and Hacker²⁹ have a most excellent article on this subject, comparing the thymol and oil of chenopodium treatment. Anyone interested in this subject should by all means consult this article as it contains considerable information regarding the examination of the stools as well as the technic of the treatment. Space prevents us to do more than state that these observers, after a very considerable experience, believe that as a routine

²⁸ *Journal of Infectious Diseases*, July, 1918, p. 1.

²⁹ *Journal of the American Medical Association*, February 23, 1918, p. 499.

one-half of the maximum dose (0.5 c.c. three times or 1.5 c.c.) of oil of chenopodium is the treatment to be especially recommended. They found it more uniform in action and less unpleasant to take than thymol.

Epidemic Influenza. As is only too well known, the whole world, or at any rate, Europe and America, has suffered from a devastating epidemic which resembled rather closely the pandemic of 1889-90. There are numerous accounts of the history of influenza, and a very complete recent history is that of Marco del Pont.³⁰ Of course, in the earlier accounts of epidemics one is never quite certain of the exact nature of the disease, but there is no doubt that devastating epidemics have occurred in very early times. Hippocrates and Livius described the catarrhal affections which were suggestive of epidemic influenza. The name influenza dates from the epidemic of 1743. An interesting full account will also be found in volume I of Hirsch's *Handbook of Geographic and Historic Pathology*.

The first epidemic in North America occurred in Massachusetts and Connecticut in the summer of 1627. The disease recurred in North America in 1655, and in the pandemics of 1732, 1737, 1767 and 1789-90; in 1798, 1815, 1824, 1826, 1832, 1843, 1850, 1857, 1861, 1873-74, and the big pandemic of 1889-90. It seems highly probable that these pandemics or epidemics were the same disease or the same disease plus various complicating infections, and the chief point of interest is their periodicity and the fact that the progress has always been from east to west in a general way, the disease generally starting from some center and gradually or rapidly, as the case may be, spreading over the world or large parts of it. In many instances horses have also been affected at the same time.

Pfeiffer's classic work about influenza appeared in 1893, and detailed his investigations in the end of the epidemic which started in 1889-90, but which he studied in 1891. He isolated the organism which is very frequently associated with his name, and this has been more or less generally accepted as the cause of influenza.

A very good review of foreign literature has been compiled by the British Medical Research Committee.³¹ This review is of particular interest inasmuch as we have not had the opportunity of seeing the German and Austrian journals. They list these and other contributions, as appended to the report. Following the subsidence of the epidemic of 1890, there were localized epidemics of influenza-like diseases in various parts of Europe. The Pfeiffer school has maintained that the epidemic was due to the Pfeiffer bacillus and the so-called endemic group, caused by a large number of bacteria, chiefly those belonging to the coccil group. Stephan, in 1916, described a diplococcus mucosus as the agent of clinically typical endemic influenza in Leipzig. In 1915, cases were described in England, and Shera claims to have isolated an organism similar to the influenza bacillus. In 1917, unusually virulent cases of purulent bronchitis were noted in the base hospitals in France,

³⁰ La Semana Medica, July 4, 1918, p. 1.

³¹ Journal of the American Medical Association, November 9, 1918, p. 1573.

and Hammond, Rolland and Shore³² described a Gram-negative coccobacillus which they identified as Pfeiffer's organism. Others found similar organisms, together with the pneumococcus. In London, in 1918, there was an epidemic of infective encephalitis in which a Gram-negative diplococcus resembling the pneumococcus was obtained. In England, various organisms were described and associated with the epidemic, and some observers believed that the bacillus influenza was the predominating organism, while others either did not find it or only sparingly. In Germany, the disease attracted a very considerable amount of attention and the comparison of postmortem findings with the organs preserved since 1890-92 showed identical lesions.

Before going any further, it might be well to call to mind that this present epidemic presented a clinical picture not ordinarily met with in practice. One can feel certain that he is dealing with a disease which is not met with every day, or one which had had its characteristics very greatly changed through unknown causes. The etiology of the disease cannot be regarded as settled at this time. I shall comment below more fully on the bacteriological findings, but will make the matter more clear if I call attention to the fact that it is not known whether or not the disease is due to a filterable virus or to ordinary bacteria. The observations are singularly conflicting; thus Selter was said to have produced a particularly mild attack in two persons by spraying the throat with a filtrate of the throat secretion of persons suffering with the disease, and opposed to this observation is that of Keegan³³ who took the filtrate of throat and nasal washings and introduced it into the anterior nares of nine volunteers, with negative results. It is perfectly clear that these observations will have to be repeated before the question can be regarded as settled, although Keegan's observations were exceedingly well controlled. From the various parts of the country and the various army camps have come conflicting statements as to the bacterial findings. Some have found the influenza bacillus, some the *Streptococcus viridans*, *Streptococcus hemolyticus*, *Micrococcus catarrhalis*, and from cases with pneumonia, often pneumococci.

Little, Garofalo and Williams³⁴ believe that a pleomorphic Gram-positive coccus is the probable etiological factor. It has been put down by others as probably a pneumococcus from the mouth. Gotch and Whittingham³⁵ believe that the *Micrococcus catarrhalis* is the cause of the disease. By this we see that a large number of organisms have been described as occurring with the disease, and each has been thought to be the cause by one or more competent observers. The findings are varied in different parts of the country, and various reports are made with almost an air of finality.

It will be impossible to consider very many of them, but, for example, Keegan, one of the naval surgeons in the Massachusetts epidemic, from a study of the smears and cultures from lung punctures and necropsies,

³² Lancet, London, 1917, ii, p. 41.

³³ Journal of the American Medical Association, September 28, 1918, p. 1051.

³⁴ Lancet, 1918, ii, p. 34.

³⁵ British Medical Journal, 1918, ii, p. 82.

showed the influenza bacillus, either pure or mixed, in 82.6 per cent. of the cases studied, and in those cases in which it was found there were pure cultures of a hemolytic streptococcus. In 31.6 per cent. of the positive cases the influenza bacillus was present in pure culture, and these were all pneumonias of short duration, none more than four days' and two of only two days' duration. Keegan found that of the most common secondary invaders the pneumococcus appeared in 56.5 per cent. Of these, 46.1 per cent. were Type II, the others scattered among the other types of the organism. He noted also that a separate type of infection occurred in the two lungs, one being both the influenza bacillus and pneumococcus infection and the other gave a pure culture of streptococcus or *Micrococcus catarrhalis*. In his observations he concludes that the influenza bacillus is a primary invader in all cases of pneumonia complicating influenza, and that it is frequently complicated with the organisms named and the secondary infections may be separate, double or triple.

Nuzum, Pilot, Stangl and Bonar³⁶ had the opportunity of studying a large number of cases in the wards at Cook County Hospital in Chicago. They found the influenza bacillus in only 8.7 per cent. of the total cases, chiefly from a small group of soldiers. The pneumococci were the predominating organisms in the sputum, throat cultures and lung cultures, both during life and at necropsy. The following table shows the percentage incidence of the various bacteria isolated from the nasopharynx, sputum and tonsils in various cases:

PERCENTAGE INCIDENCE OF VARIOUS BACTERIA ISOLATED FROM THE SPUTUM, NASOPHARYNX AND TONSILS IN 100 CASES OF INFLUENZA.

	Pneumo- coccus, per cent.	Bacillus influen- zae, per cent.	Strepto- coccus hemolyt- icus, per cent.	Staphyl- ococcus, per cent.	Micro- coccus catarr- halis, per cent.	Bacillus mucosus capsu- latus, per cent.	Miscellaneous.
Washed bronchial sputum	70	4	20	40	5	1	Diphtheroids, 1 per cent.
Nasopharynx	38	0	4	65	5	1	Leptothrix 2 per cent. Meningococcus 2 per cent.; diphtheroids, 1 per cent.
Tonsil	74	0	37	37	7	1	Diphtheroids, 1 per cent.

They noted that the pneumococcus was found in 70 per cent. of the washed sputum, and from the throat in 74 per cent. of the cases, while the *Streptococcus hemolyticus* occurred in the washed sputum in 20 per cent.

Strouse and Bloch³⁷ found the *Streptococcus viridans* showing a narrow zone of hemolysis after twenty-four hours, the pneumococcus and staphylococcus being the most frequent organisms. Typical *Streptococcus viridans* and hemolyticus were also described, as were the *Micrococcus catarrhalis* and Friedländer's bacillus. The streptococcus

³⁶ Journal of the American Medical Association, November 9, 1918, p. 1562.

³⁷ Ibid., p. 1568.

found by a number of observers is described as a diplococcus and streptococcus and had a tendency to grow in long chains under favorable conditions. Just what these organisms are is not clear, as many of the reports do not give a sufficient amount of data to enable one to determine.

The postmortem findings in the fatal cases showed a bronchopneumonia in practically all.

Christian³⁸ calls attention to the fact that in 126 consecutive fatal cases at the Peter Bent Brigham Hospital, not a single patient failed to show physical signs justifying a clinical antemortem diagnosis of bronchopneumonia. In 22 consecutive necropsies of this group, no single case failed to show pathological changes in the lung justifying the diagnosis, and these changes were, as a rule, more extensive than the physical signs during life indicated.

The lesions, as described in the abstract of the British Medical Research Committee, varied considerably; in some instances there were small bean-sized hemorrhages in the lung tissue, in others there was a primary infiltration, the nodules raising the pleura when they were on the surface; all sizes and shapes of lesions were met with, which also showed all possible gradations, from simple blood extravasations into the lung tissue still containing air, to firm, almost dry, infarct-like hemorrhages of a bluish-black tinge. The second stage of the disease showed pneumococcic exudates and processes combined with hemorrhages, sometimes looking like the red hepatization of ordinary pneumonia, but being limited to lobules of the lung, although at times whole lobes were involved. The centers of these infiltrations usually showed hemorrhages. In the first stage the bronchi were filled with pus, and the smaller branches contained a thin fluid and sometimes dried up exudates. In some instances abscess formation was noted. The pleura showed punctiform hemorrhages or ecchymoses, serous exudates and occasionally, but not often, empyema. These lesions, as a rule, were found only on one side. In these cases pericarditis was sometimes noted, and occasionally there is an incipient endocarditis. The spleen is enlarged, and little, but seldom, involved. There is a general congestion of the kidneys.

The symptoms of the disease are so firmly fixed in our minds from the experience we passed through that it is hardly necessary to make any extensive reference. The onset of the disease is, as a rule, very sudden, the patient passing from apparent health into marked prostration within an hour or two. In a few instances the patients have complained of slight sore-throat or of feeling badly for a few days, but in most there was no previous symptom. The temperature rises rapidly from 101° to 105° and more, severe headache, very marked weakness and severe pains in the muscle joints and back. The disease is so severe in most cases as to cause the patient to go to bed. They complain of alternating chilly or warm sensations and most of the patients are in a semistupor, with a very marked flushing or cyanosis. Nose-bleed was frequently met with, and while, as a rule, there were no gastro-intestinal symptoms,

³⁸ Journal of the American Medical Association, November 9, 1918, p. 1565.

some cases had nausea and vomiting and occasionally diarrhea. After two or three days the temperature remitted and in a few cases the patient recovered at this time. In most, there was a secondary rise, and, with this, came coryza, sore-throat and signs and symptoms of bronchitis if these had not been present before. The temperature gradually returned to normal, so that within the week the majority of cases were well, although not able to be about much. Following the disease there was a marked weakness, and a tendency to sudden sweating and great fatigue on slight exertion. In children, the disease was usually much milder than in adults, and the onset almost always accompanied with a slight conjunctivitis, a reddening of the fauces, and, after two or three days, coryza and bronchitis, and this was sometimes present at the onset.

The blood cultures are usually negative, and in the uncomplicated cases there is no leukocytosis, a point of some value in differential diagnosis. Keegan studied the blood in 28 cases, and found there was an average of 6700 white cells with a differential count of polymorphonuclears, 63.7; lymphocytes, 33.3; large mononuclears, 1.2; transitionals, 1.2; eosinophiles, 0.21; basophiles, 0.035; essentially a normal finding. Nuzum and his co-workers referred to above, describe a marked leukopenia in blood counts taken soon after the onset of symptoms. They also noted that with the onset of pneumonia there was a definite leukocytosis.

Forbes and Snyder³⁹ made a study of the blood in an epidemic that occurred at Camp Hancock in cases under observation from the first to the sixth day of the disease. In a few cases that were not recorded in which the differential count was made in from ten days to three weeks of the illness, they found that the relative lymphocytosis had not disappeared. They found that a complicating bronchopneumonia decreases rather than increases the lymphocytes. There was an absence of hyperleukocytosis, so that the blood picture is characterized by a leukopenia and a relative lymphocytosis, and this point may be of value in the early diagnosis in differentiating the disease from scarlet fever. There is considerable variation in the degree of lymphocytosis, and ten of the thirty-two preparations gave a total mononuclear count above 50 per cent. They made some observations on the occurrence of the influenza bacillus which they did not find in the blood stream of ordinary or mild cases, but did in the very severe or fatal cases.

In a varying proportion of cases pneumonia developed which was particularly fatal, especially between the ages of eighteen and thirty-five. In many instances the picture was that of a patient suffering with air-hunger, such as occurs in toxemias, the rapid respiration and marked cyanosis being the marked features, whereas in other cases there was a tendency to respiratory failure. Strouse and Bloch regard the respiration rate as having more significance in prognosis than almost any other sign. They found a normal or slightly diminished systolic blood-pressure, but the diastolic pressure was lower than was to be expected, a pressure of 40 being not infrequently met with and where

³⁹ Journal of Laboratory and Clinical Medicine, St. Louis, September, 1918, p. 758.

the diastolic pressure was high, some cause was to be found, as a nephritis. In the previous epidemic of 1890, ear complications were very common, whereas in the present epidemic otitis was rather exceptional.

In women, practically all menstruated between the first and third day of the disease. There have been but few reports on this subject which will doubtless find its way into the literature later. The effect on pregnant women or those recently delivered was very striking. They showed a rapid course, with marked cyanosis, dyspnea, rapid pulse and a very massive pneumonia, often hemorrhagic, came on very early and death in most cases took place within the first few days. Most of the pregnant women aborted or if the pregnancy was near time birth took place. This observation is not confined to this epidemic but has been previously noted. Ball,⁴⁰ for example, calling attention to statements to this effect made by Zuelzer, in 1875 edition of Ziemssen's *Encyclopedia*. Ball, as well as others, has raised the question as to whether the *Bacillus abortus* of Bang, which seems to be closely allied to the influenza group, may not have something to do with this phenomena.

Among the numerous contributions on influenza are a series lately published.⁴¹ These numbers contain, among other things, a succinct account of the pathology by Symmers, the clinical aspects by Berg and Bullowa, and the treatment by Bastedo. Mix gives an interesting account of the disease as it occurred in the Army at Camp Mills, and Copeland gives a general review of the subject. Jelliffe has also given an account of the *nervous and mental disturbances*, and it is interesting to note that he chronicles the olfactory disturbances, the commonest being a loss of smell, which may be noted in from four to five days or as late as ten days after the onset. In one instance there was also a loss of taste as well, and in another patient a loss of hearing. Olfactory hallucinations have been reported. Optic neuritis, while rare, has been met with; and external ocular palsies, either alone or combined with internal paralysis; and also involvement of the pharyngeal pillars or some of the laryngeal muscles may be seen. The resemblance to diphtheria paralysis is very striking. The fifth nerve is frequently disturbed, but only the sensory part of it. Facial paralysis was not at all uncommon and may or may not be associated with disease of the middle ear. The eighth nerve may be involved, with production of marked tinnitus, and in some instances vertigo and nystagmus of vestibular origin were reported. Less is known about the ninth nerve, but hoarseness and difficulty in phonation and in swallowing are very mild accompaniments of the disease. Neuralgias and zoster may occur in any part of the body. Supra-orbital and intra-orbital are perhaps the most common.

The *prognosis* was exceedingly difficult, many of the severe cases making perfectly good recoveries without complication, while at other times a patient apparently but slightly ill developed a pneumonia or very marked toxemia and died almost without warning. The mortality was highest in young adults, and low in children and older people. Part

⁴⁰ Journal of the American Medical Association, October 19, 1918, p. 1336.

⁴¹ New York Medical Journal, Oct. 12, 1918, No. 15, cviii, and October 26, 1918, No. 17.

of the high mortality was due to patients getting up and going about too soon, and part also was due to lack of nursing owing to the large number of persons being affected at the same time. The mortality at the Army camps was very high; at the time of the writing of this review the official figures were not available.

The *diagnosis* of the disease is comparatively easy, although undoubtedly a great many things that were not influenza were set down as such in the reports. The diagnosis was made chiefly on the clinical picture. Where there was stiff neck or slight Kernig's sign, lumbar puncture was needed to exclude meningitis. There was no way of differentiating the ordinary colds and bronchitis, except that the amount of constitutional disturbances was more than is ordinarily met with in these common infections. There was some question as to whether one attack confers an immunity or not, and it was thought that older people who had had the disease in the previous epidemic escaped in this one.

The *prevention* of the disease is summarized by Lumsden.⁴² He advises keeping in good condition and to avoid all needless crowding, walking in place of taking the street cars, when possible. He also advises going to bed an hour earlier and getting up half an hour earlier to permit of extra time for walking. As far as possible, one should stay in the open air and sunshine, and, if it is necessary to go into poorly ventilated places, breathing through the nose should be practiced. Clothing should be loose and sufficiently warm, and the feet should be kept warm and dry. He, along with others, advocates the avoidance of talking, sneezing or snuffling persons, and the washing of the hands after handling a case and before eating, and also the avoidance of using towels, glasses, napkins, spoons, forks, etc., that have been used by others. Unless it is necessary to visit houses where there is influenza, it is better to keep away from it. In hospitals and in the sick room the wearing of face masks was generally advocated, reference to which is made in another part of this review.

The *treatment* of the disease is largely expectant. The patient should go to bed at the beginning of the first symptoms, have plenty of fresh air and sufficient bed clothing. A laxative is usually ordered at the outset and plenty of plain water given to drink. There is usually loss of appetite, so that a milk or liquid diet is generally used, but when the appetite was good, there was no objection to light food. Over-indulgence in food almost always resulted in nausea or vomiting.

To prevent complications, the patients should be kept in bed for forty-eight hours after the disappearance of the fever, and, if great weakness is present, the patient should be kept at rest until this has passed. The use of sodium bicarbonate, both in the treatment of the disease and as a preventive, found a considerable place in the talk of the laymen, and also, to a certain extent, in the medical journals. Workers in places where large amounts of soda dust were encountered, as in baking powder factories, were said to escape the disease altogether, and certain groups

⁴² Public Health Reports, October 11, 1918, p. 1731.

of workers brought in contact with the fumes of chlorine gas were also said to have escaped. The use of soda and alkalies in the treatment of respiratory infections doubtless dates back to antiquity and certainly was well known to the earlier writers, Walter Harris, for example, in the seventeenth century, giving elaborate directions for their use. The early use of digitalis when the lung complications set in is advisable, especially as the toxin of the disease seems to have a selective action on the heart muscles, and failure of the right heart is to be feared.

Vaccines. There is considerable talk concerning the use of vaccines, and various preparations are on the market, some of the influenza bacillus and some with this organism combined with streptococci and pneumococci. The use of vaccines against influenza is certainly in the experimental stage and we have no information concerning their value. It may, or may not, be of use and there is no evidence at present that it is.

Park⁴³ has a short communication in which he states that the results obtained in the New York Health Department will agree rather closely with the results of Keegan. He had prepared a vaccine made from one strain of influenza bacillus isolated from cases seen during the epidemic. This was prepared from cultures by washing the bacilli off in salt solution and subjecting the fluid to a moderate heat so as to kill it at the lowest possible temperature. The dosage at the time of the report was three injections at two-day intervals in quantities of one-half billion, one billion and two billion. He suggests that it is not probable that any appreciable immunity will develop in less than a period of five days and probably not much before ten to fourteen days. The reports of his observations, as well as those in other parts of the country, will be awaited with interest.

Administrative Control of Influenza. Harris⁴⁴ gives an account of the epidemiology of the disease and also the administrative procedures used in New York City. An educational campaign, through placards in the cars and circulars and in the newspapers, was immediately started, with general rules and instructions regarding the disease; the chief point being to avoid spitting in public places and to educate persons to use the handkerchief when coughing or sneezing. In order to prevent the over-crowding of the street cars, a relay system for opening and closing of business establishments was instituted. The public schools were allowed to remain open, as were also the theatres, and only such moving-picture theatres were closed as were found violating the sanitary laws or harboring conditions conducive to disease. These procedures certainly took courage, but seemed to be sane and scientific, and I do not believe that the prevalence of the disease will be found to have been any greater in New York City than it was in the other cities in which drastic closing regulations were in force. We seem still to be a long way off from the time when health departments will issue regulations in accordance with their knowledge of disease, rather than with the clamor of the public, and one cannot emphasize too strongly the necessity of avoiding useless restrictions in the presence of epidemics.

⁴³ New York Medical Journal, October 12, 1918, p. 621.

⁴⁴ Ibid., October 26, 1918, p. 718.

Influenzal Sinus Disease. Robertson⁴⁵ reports several instances of this affection, with a short bibliography, and states the belief that it is possible that too little consideration has been given to chronic sinus disease as furnishing foci for the spread of epidemics. There have been frequent and severe epidemics of influenza of the respiratory tract, generally characterized by a purulent tracheobronchitis, both in the American and British Expeditionary Forces, and very little attention has been paid to the question as to whether the sinuses were involved or not. In 8 fatal cases which Robertson studied, all but one showed involvement of one or more of the sinuses at the base of the skull, but not all cases were directly due to the infection of the influenza bacillus, and in 6 patients who died from some other apparently independent infection, the sinuses showed influenzal inflammation, and 2 patients who died from accidentally received injuries also showed lesions in the sinuses of pure cultures of the influenza bacillus. Robertson suggests that patients suffering from influenza should receive appropriate treatment for the sinuses if involved, and during epidemics, as indicated above, believes that special attention should be paid to these possible foci of infection.

Acute Infectious Jaundice in the United States. Neill⁴⁶ has made a review of this subject. It is highly probable that the majority, if not all, the cases of this disease are due to the leptospira icterohemorrhagica described by Inada and his co-workers in 1916. This organism was first demonstrated in a severe form of the disease prevailing at the time in Japan. The organism produces a disease which is acute in character, but which may vary from very mild cases, ordinarily not to be differentiated from catarrhal jaundice and therefore seldom diagnosed in the absence of an epidemic. There are a varying degree of fever, malaise, prostration and some gastro-intestinal symptoms, and jaundice of a varying degree and duration. Severe cases show albuminuria and bleeding from mucous surfaces. The fever and prostration are the most important points in suggesting the diagnosis, as well as the absence of local signs of biliary disease. There have been a number of outbreaks of jaundice in the United States, one occurred among the troops in the war of 1812, and 71,690 cases were reported in the Union Army during the Civil War, some sporadic and some in local epidemics. These figures are, perhaps, not reliable on account of the possible association of jaundice with diseases of the liver and malaria, but, nevertheless, there are cases of clear-cut epidemics. In the civil population there have been a number of outbreaks, 19 of which are tabulated by Neill. These epidemics ranged from 1849 to 1915, the largest being in Calumet, Michigan, in 1897 and 1898, during which time 875 cases were observed. The importance of the rat and other rodents in connection with the disease is emphasized, and a bibliography of the more important contributions is appended.

Wild Rats and the Leptospira Icterohemorrhagica. Jobling and Eggstein⁴⁷ have made a study of white rats caught about Nashville, Tennessee. More than one hundred animals were examined, and, of these,

⁴⁵ Journal of the American Medical Association, May 25, 1918, p. 1533.

⁴⁶ Public Health Reports, May 10, 1918, p. 717.

⁴⁷ Journal of the American Medical Association, November 24, 1917, p. 1787.

more than 10 per cent. were found to harbor the organism. Noguchi has previously shown that the rats about New York City are similarly affected, and it is highly probable that a study of these animals in other places would furnish similar results. Inasmuch as infectious jaundice may play a very important part in the health of troops, this is another argument in favor of the extermination of the rat.

Intravenous Serotherapy of Infectious Jaundice. Two years ago Inada, Ido, Hoki, Ito and Wani⁴⁸ reported the results of their studies with subcutaneous injections of immune serum in spirochetosis icterohemorrhagica or Weil's disease. More recently they have shown that the intravenous injection of immune serum far exceeds in potency the subcutaneous injection. They explain this on the basis of the observation of Berghaus, that the effect of serum injection directly into the blood stream is five hundred times more potent than when injected subcutaneously. The immune bodies could be demonstrated as complete five minutes after the intravenous injection of 0.5 c.c. of serum per kilo of body weight, whereas after subcutaneous injection the immune bodies could be detected only eight hours later. This passive immunity so induced continues for three to four days. It was found that in man it was not possible to bring about a complete passive immunity when the subcutaneous method was used, but this could be done with the intravenous method.

The best results were obtained when the injection was made at an early stage of the disease. Their observations show that the serum was capable of destroying the spirochete in the blood stream within a short period of time. For example, in one observation two hours after the intravenous injection of the serum no microorganisms could be demonstrated. Of 41 patients under observation, 12, or 23.7 per cent., died. They did not take into account in the figures a patient who recovered, but died on the fifty-fifth day from complications, or two patients admitted when moribund. The mortality in patients receiving no serum was 30.6 per cent., whereas in those subcutaneously injected the percentage was 70.3. The low mortality in the subcutaneously injected patients is attributable to the fact that in this group, which entered before the eighth day of illness, only 5 patients were over forty years of age, while in the group of intravenously injected persons, 12 were over that age. The serum is effective only when administered in the initial stage; after the sixth day it was not satisfactory. The mortality of patients who were admitted before the seventh day and received no serum was 57.1 per cent.; of the subcutaneously injected, 40 per cent.; and of the intravenously injected patients, 38.5 per cent. It is important, in comparing figures, to take into account other factors, such as the age of the patient, the severity of the illness, the season of its occurrence, and, above all, the day of illness on which the serum was administered first, and also whether the disease is occurring in epidemic form or sporadically.

When the serum is administered early, the disease appears to assume a milder form, but the fever does not seem to be influenced to any extent, even in cases where the serum has been given early and there is often a

⁴⁸ Journal of Experimental Medicine, 1918, xxvii, p. 283.

rise of temperature after an injection. The jaundice clears up earlier in injected cases, and there is a decided lessening of hemorrhages. The serum produced little, if any, effect upon the pulse, although arrhythmia was less frequent. It occurred in 20 per cent. of the cases treated with serum and in 50 per cent. of the untreated. It was also found that the use of the serum greatly reduced the complications, such as the suppurative processes—parotitis, and skin abscesses.

Kaneko and Okuda⁴⁹ have made a study of the distribution of the leptospira in the organs after intravenous serum treatment. They studied material from 8 cases of Weil's disease obtained at postmortem. All the patients had received intravenous treatment before the eighth day of the illness. The distribution of the spirochete differs somewhat from that in those receiving no serum treatment. In the serum-treated cases the organisms are not as numerous and are apt to be degenerated. The serum seems capable of destroying the spirochete found within the organs in man with the exception of the kidneys. The action of the serum is to kill and dissolve the organism. The spirochete disappears almost completely from the organs during the convalescent stage of the disease, even when no serum has been administered, but, as in the case of the serum-treated, the kidney still remains infected.

The Experimental Prophylactic Inoculation Against *Leptospira Ictero-hemorrhagicæ*. Noguchi⁵⁰ has made some observations along this line, inoculating guinea-pigs with suspensions of the organisms obtained from pure cultures of several different strains. This was done for the purpose of determining whether or not an active immunity could be developed in animals sufficient to protect from a subsequent infection with virulent organisms. The inoculations were repeated subcutaneously on three different occasions at intervals of five days, using various sized doses in different groups of animals. The degree of immunity produced was determined by inoculating intraperitoneally several minimum lethal doses of each of the five strains of organisms. Three strains were American, one was Japanese, and one European. The virulence of the strains varied considerably, the strongest being the Japanese which killed a guinea-pig in a dose of 0.00001 c.c., and the weakest the American strain number 3, the minimum dose of which was as large as 0.01 c.c.

The tests for immunity were made two, four and eight weeks after the last inoculation. It was found that three successive inoculations of 0.5 c.c. of the killed cultures rendered the pigs immune to a subsequent infection with the virulent cultures of both homologous and heterologous strains. The smaller doses sometimes would produce immunity, while the smallest dose used would protect against the particular strain employed, but not against the others. Noguchi concludes, therefore, that when a sufficient quantity is used, the immunity to all strains of the organism may be produced, and he recommends that in the preparation of vaccines a polyvalent vaccine, that is, as many different strains as possible, should be employed. The active immunity in the pigs was found to persist for at least eight weeks, and will, in all probability, continue for a much longer period.

⁴⁹ Journal of Experimental Medicine, 1918, xxvii, p. 305.

⁵⁰ Ibid., November, 1918, p. 561.

Kala-azar in a Child. THE FIRST AMERICAN CASE. Talbot and Lyon⁵¹ describe a case of this disease occurring in the Children's Service in the Massachusetts General Hospital in 1916. The patient was a Greek and came to this country in December, 1915, had pneumonia in January, 1916, followed by enlargement of the abdomen and later symptoms led to her entrance to the hospital. Leishman-Donovan bodies were demonstrated with a smear from the spleen and grown in the lymph nodes.

This case emphasizes the necessity of being on the lookout for this disease, particularly in foreign-born children. The case in question recovered under the use of tartar emetic given intravenously after the method suggested by Rogers.

Treatment of Leprosy with Sodium Gynocardate "A." Muir⁵² reports the use of this drug after three months' treatment. A 3 per cent. solution with 1 per cent. pure phenol, and 1 per cent. sodium citrate was prepared and sterilized by boiling in a flask immersed in another vessel containing water, and 0.5 to 5 c.c. were given three times a week intravenously. Tablets of the same drug were also used by mouth, but their use did not seem to make any difference in the results. All of the patients treated showed anesthesia and in 20 cases there were marked tubercular nodules. The most rapid progress was noted in the youngest patients and in those who had been ill for a short time; some of the patients lost all of their anesthesia, while very many, although weak at the end of three months' treatment, were cheerful and hopeful.

Measles. THE BACTERIOLOGY OF MEASLES AND GERMAN MEASLES. Last year I commented on the observations of Tunnicliff⁵³ and she now has published another article in which she describes a diplococcus which she has isolated from the blood of patients with measles and also with German measles. The two organisms are similar in their cultural characteristics, but differ in size, shape, capsule formation, filterability, viability, virulency and immunity reactions. Blood cultures were made from 50 patients in the preëruptive and the eruptive stages and in 5 when the rash was fading. A small micrococcus was observed in the original anaërobic cultures in 42 of the early cases, and these organisms were found in all of the last 15 cases studied.

THROAT SMEARS IN GERMAN MEASLES AND SCARLET FEVER. Tunnicliff⁵⁴ believes that examination of swabs from the tonsils and anterior pillars of the fauces is of value in making differential diagnoses in the above diseases. She states that there is rarely much difficulty in differentiating a mild case of scarlet fever from rubella. Throat smears are helpful in differentiating these two diseases, especially if taken in conjunction with a leukocyte count, there would be an increase of leukocytes in scarlet fever and a decrease in rubella. The smears from measles showed a variable number of polymorphonuclears and epithelial cells, and many small, round diplococci, about 0.5 micron in length.

⁵¹ American Journal of Diseases of Children, September, 1918, p. 154.

⁵² Indian Medical Gazette, June, 1918, liii, No. 6, p. 209; and Journal of the American Medical Association, September 28, 1918, p. 1094.

⁵³ Journal of Infectious Diseases, 1918, xxii, p. 462.

⁵⁴ Journal of the American Medical Association, July 13, 1918, p. 104.

Those from German measles showed few, if any, leukocytes, but many epithelial cells containing elongated, pointed cocci in pairs, sometimes in chains, and often with a narrow capsule. The diplococci are also seen outside the cells, but are especially characteristic when on the epithelial cells. Smears from scarlet fever show many polymorphonuclear leukocytes and a variable number of cocci, usually round, in pairs, or chains of rarely more than four, and there is generally a wide capsule. The three types of organism described are not found in any normal throats except in four instances when the rubella cocci was found in persons closely associated with German measles patients. This organism was also in 3 of 8 cases of so-called simple sore-throat, 2 in roommates and 1 in a nurse of German measles patients.

STREPTOCOCCUS AND MEASLES. The unavoidable epidemics of measles occurring in the various cantonments have given rise to quite a number of contributions. Of particular interest and importance are those dealing with the relation of the streptococcus to measles complications. For instance, Irons and Marine,⁵⁵ in a study at Camp Custer, Battle Creek, Michigan, saw approximately 200 cases of measles during the fall and early winter of 1917, with only three complications, otitis media in each instance. Late in December and early in January, with the advent of colds, acute bronchitis, pharyngitis and tonsillitis in the cantonment, there were a large number of pneumonias, some 30 in all, including 14 fatal cases, 12 of which followed measles. These complications were caused by streptococcus infections, and they believed, and very properly so, that exposure, fatigue and measles all acted in reducing the resistance, and, when there is a pretty general distribution of streptococci, as during an epidemic of colds and bronchitis, serious complications are liable to follow.

Levy and Alexander⁵⁶ and Levy⁵⁷ have also shown the predisposition of streptococcus carriers to the complications of measles. In the report of a commission sent by the Surgeon-General of the Army to study the pneumonia at San Antonio, Texas, it is pointed out that a relatively small number of measles patients (11.4 per cent.) were streptococcus carriers on their admission to the hospital, but that many more acquired the *Streptococcus hemolyticus* for the first time on their admission to the wards; and that, therefore, the high incidence of bronchopneumonia and empyema during the convalescence of measles at Fort Sam Houston, at least, might be directly related to the transfer of the infectious agent from one patient to another in the wards of the hospital.

Levy and Alexander found that out of 388 measles patients admitted to the hospital at Camp Zachary Taylor, Kentucky, 299, or 77.1 per cent., were found to be carriers of the *Streptococcus hemolyticus*. An attempt was made to prevent the contamination of non-carriers by the carriers in the hospital, by making throat cultures and separating the two groups. In the wards, rigid precautions were observed, the most important of which were cubicle isolation, the feeding of each patient in his own cubicle and by supplying orderlies and nurses who, by throat cultures, had been proved non-carriers, and the like. In 30.6 per cent.

⁵⁵ Journal of the American Medical Association, March 9, 1918, p. 687.

⁵⁶ Ibid., June 15, 1918, p. 1827.

⁵⁷ Ibid., March 16, 1918, p. 775.

there were complications, a number of the patients suffering from more than one, bronchopneumonia heading the list. It was found that complications occurred almost exclusively among streptococcus carriers, the incidence in this group being 36.8 per cent. as contrasted with 6.4 per cent. in the non-carriers. It was further noted that the complications in these non-carriers were of a distinctly minor character. They point out that in order to prevent complications in measles, the carriers and non-carriers of the streptococci must be separated and cared for in different wards, and the clean wards kept free from the organism. Attempts at eradicating the organism from the throats of carriers by use of mouth antiseptics were failures, and 71.7 per cent. of the patients discharged from the hospital still harbored the *Streptococcus hemolyticus* in their throats. A representative company of 95 men which had furnished 89.1 per cent. of measles patients were found to have 79, or 83.2 per cent., streptococcus carriers, although the individuals were apparently healthy, whereas the examination of 489 new recruits as they stepped from the train showed the incidence of 14.8 per cent.

THE POSSIBLE NATURE OF MEASLES. Bristol⁵⁸ has suggested that the acute exanthemata may depend on something more than mere primary infection with bacteria. In the case of scarlet fever, for example, he believes that there is a streptococcic anaphylaxis as the combined cause of the disease. He calls attention to Jenner's statement in 1798 in which he queries whether or not many contagious diseases may not owe their present appearance not to a simple but to a compound origin. Measles, he believes, may be nothing more than the manifestation of an anaphylactic intoxication following sensitization with a well-known microorganism, and points out that measles and pneumonia seem to be coincident in a number of cases—seasonal prevalence and spread, etc.—as is evidenced in the army camps. Bristol made some studies of Koplik's spots and all the cultures from 24 cases showed the presence of pneumococci and it was grown in pure culture in 15. He suggests that measles is nothing more than a manifestation of a pneumococcic anaphylaxis, and advises the use of pneumococcus vaccine for preventing the disease.

He gives an interesting table contrasting measles and serum sickness:

CHARACTERISTICS.	MEASLES.	SERUM SICKNESS.
Incubation period.	Ten days (average).	Ten days (average).
General malaise.	Present.	Present.
Fever.	Present.	Present.
Eruption.	First in mouth (Koplik spots). Spreads to skin of face and then over entire body. Has a variable appearance. Severe itching.	First around site of injection and then spreads over body. Has variable appearance. Often indistinguishable from measles rash. Severe itching.
Edema.	Present.	Present.
Lymphadenitis.	Present.	Present.
Albuminuria.	Frequently present temporarily.	Frequently present temporarily.
Blood changes.	Early leukocytosis and later leukopenia.	Early leukocytosis and later leukopenia.
Protection.	One attack protects for variable periods of time.	One attack protects for variable period of time (anti-anaphylaxis).

⁵⁸ Boston Medical and Surgical Journal, March 28, 1918, p. 437.

The Potency of Antimeningococcus Serum. McCoy, Wayson and Corbitt⁵⁹ have made a study of the antimeningococcus serum as found in the American market to determine its potency as shown by laboratory tests. The conclusions reached by various observers regarding the value of the serum treatment in meningitis are conflicting; some reporting favorable results and others failures. Some years ago Dopter found that by serologic methods he could differentiate two groups, the true meningococci and what he called the parameningococci.

English observers, and others, have designated four types, I, II, III and IV, I and III corresponding in general to the regular meningococci and II and IV to the parameningococci. The classification is made by means of agglutination of agglutinin absorption. This grouping may be regarded as tentative. There is as yet no accepted method of testing antimeningococcus serum. The manufacturers of the serum in this country generally use the complement-fixation method, the agglutination method, the determination of the opsonins or bacteriotropins, or the animal protection test. On the other hand, the English workers generally employ the agglutination test, the French the complement-fixation method, whereas the Germans use the complement-fixation test and the determination of the bacteriotropin content. The animal protection test may eventually be found to be the best, but at present we know so little about the mechanism of infection and protection in man and of the virulence of cultures for laboratory animals, that this entire subject needs further study before it can be stated that the curative action in man and the protective action in animals run parallel.

For this reason these authors have used test-tube experiments, using one or more representative organisms of American origin, and each of the four groups determined by the agglutinin absorption method, and it was found that these embraced representative cultures which would be classified into three groups: The regular or normal meningococci, the parameningococci, and the irregular organisms. The antigens for both agglutination and complement-fixation tests were distributed to manufacturers with detailed descriptions of the use of these reagents and the method of reading the results obtained. It was also arranged that the serum should not be released until samples had been tested and passed at the Hygienic Laboratory.

The American serums that are now on the market are polyvalent and were made by immunizing horses with from thirty to eighty strains of meningococci, most of which have been isolated in this country. The same manufacturer may put out different lots of serum with considerable variations; and even the same lot of serum may show different titers on different antigens made from the same strains, and even on the same antigen. Up to the present time, the tests only show that the serum examined has been derived from a horse immunized with the various serologic groups in this country. It is, of course, greatly to be desired that the meningococcus serum be more thoroughly studied and standardized.

⁵⁹ Journal of the American Medical Association, July 27, 1918, p. 246.

French Methods in the Treatment of Cerebrospinal Fever. Dopter⁶⁰ has written a little book on this subject, which contains a certain amount of information that it is well to review. The usual methods are advised, that of bringing the serum into direct contact with the organisms in the body; this means the intraspinal use of the serum and, where there is a septicemia, the intravenous use, while local infections with the meningococcus, such as pleuritis, arthritis and corneal ulcer, are treated by direct application of the serum. The recumbent position on the side at the edge of the bed is recommended for lumbar puncture, and the space between the fourth and fifth lumbar vertebrae is located by drawing a line from one iliac crest to the other, this line representing the upper limit of the space. The needle is introduced in the median line in a slight upward direction. In order to reach the upper parts of the sub-arachnoid space, it is recommended that the patient be placed with the hips elevated and the head and chest lower. This position is retained for two or three hours.

He also notes that the spinal canal may be washed out with warm sterile salt solution previous to injecting the serum, the amount of salt solution used being equal to the amount of serum withdrawn. This method is believed by some, notably Aubertin and Chabanier, to be better than the injection of the serum only. The French never seem to have taken kindly to the standardizing of serum, and have indicated the amount in cubic centimeters, so that the number of units used is more or less guess-work, but Dopter recommends large quantities, never less than 20 c.c., for an adult and either slightly less or more than this amount in young children. Dopter recommends the daily injection for three or four days, or even two injections daily in case the patient's condition is not improving. He also believes that the best indication, as regards the prognosis, is made by study of the cerebrospinal fluid. As long as this shows the presence of leukocytes and meningococci, the injections of the serum should be continued. If there is a sudden disappearance of symptoms, followed by a reappearance, it may indicate a recurrence of the meningitis or certain changes in connection with the use of the serum. If the former is the case, the cerebrospinal fluid contains leukocytes and meningococci. In the serum disturbance these are not present.

The meningeal irritation from the serum is described by Dopter as generally coming on from the seventh to the ninth day after the first injection, and is characterized by headache, stiffness of the muscles of the neck, and vomiting; if the serum is again used, the meningeal symptoms recur after each injection. At the same time there may be urticaria, or swelling and pain in the joints. The serum, as indicated above, is clear, there may be some leukocytes, but they are more or less perfect and not degenerated as in meningitis. The organisms are not seen.

During the early part of the war, injections were not given until the patient had been removed behind the lines, and the death-rate at this time was very high, from 45 to 55 per cent., but later, when the injec-

⁶⁰ Diagnostic et traitement de la méningite cérébrospinale. Journal of the American Medical Association, July 6, 1918, p. 35.

tions were given early, the rate was lowered to about 15 per cent. Failures in the course of the treatment may be due to the fact that there is an unusually severe infection or that the serum, when injected, is not evenly distributed through the subarachnoid space and so does not come into contact with the offending organism, or the failure may be due to the presence of other organisms, such as staphylococci, streptococci, pneumococci, etc. It must, of course, be borne in mind that meningitis due to other organisms is not influenced by the serum. He also notes the fact that patients with marked cerebral symptoms do not show as good results as the other cases. When the lesions are away from the meninges, there may also be untoward results. In resistant cases he has reason to believe that when lumbar punctures fail, cervical punctures between the sixth and seventh vertebrae have been used. In some cases, owing to the inflammation of the ependyma, the free circulation between the ventricles and subarachnoid space may be interfered with, and the protracted cases of the disease may be of this type. In these cases the serum may be injected directly into the ventricles, following the method of Cushing and Sladen. From 30 to 60 c.c. of fluid may be withdrawn, and from 20 to 30 c.c. of serum injected. In infants the puncture is started at the external angle of the anterior fontanel, about 2.5 cm. from the median line and from thence downward and a little inward at an angle of about 20 degrees. In infants the ventricle is reached in from 2 to 4 cm. In older children and adults it is necessary to trephine before making the injection. This method should not be used by anyone not thoroughly familiar with the technic of brain surgery, so that details need not be gone into.

Experimental Meningococcus Meningitis. Black,⁶¹ in 1915, published some observations on the prophylactic meningococcus vaccine and its use in preventing the spread of the disease. Following this publication, Austrian,⁶² using rabbits in place of monkeys, owing to the difficulty of securing the latter, was able to develop a satisfactory technic for the production of meningeal infection. It was found that material injected into the spinal canal will rapidly spread throughout the subdural space. The disadvantages of rabbits in the study of meningeal disease are, (1) it is difficult to avoid injury to the spinal cord when injections are made, and (2) the spinal fluid, normally and in disease, is so scanty that the withdrawal of it by aspiration was impossible.

The same author⁶³ noted that the infection in the rabbit differs from that in man and in monkeys in that there is a very small amount of fibrin in the exudate and not much increase in the amount of fluid. Even though the organisms were introduced into the lumbosacral region, the inflammatory reaction was most marked at the base of the brain, which corresponds with the observations of Flexner in the same disease in monkeys, which is against the infection being through the nasal mucosa. Austrian also attempted to find out whether or not a meningococcal meningitis could be produced by other routes of infection. Weigert

⁶¹ Journal of the American Medical Association, 1914, lxxviii, 2126.

⁶² Johns Hopkins Hospital Bulletin, 1916, xxvii, 237.

⁶³ Ibid., August, 1918, p. 183.

was responsible for the idea usually accepted that the organism goes from the nasal mucosa through the ethmoid sinus to the base of the brain, but the occurrence of a meningococcus bacteriemia, which is most often found in the early stages of the disease, seems to show that infection of the blood stream may also result in the development of a meningitis.

Twenty rabbits were injected with a standard suspension of meningococci into the nasal mucous membrane, but not one of the animals developed meningitis. Two developed positive blood cultures, but this may have resulted from the injection into a small bloodvessel in the nose. Similar results followed the use of a fresh ointment of meningococci in vaseline. Injections into an ear vein also gave negative results, the organism disappearing from the peripheral circulation in from fifteen to seventy-five minutes. Owing to the fact that the interchange between the meningeal and systemic circulations is increased by hyperemia of the choroid plexus, the preliminary irritation of the meninges was studied with reference to infection both through the nasal cavity and through the circulation. It was found that following the injection of small amounts of normal rabbit serum into the spinal canal attempts to infect the animal through the nose were negative, but when the organisms were injected into an ear vein meningitis generally resulted. These observations, if confirmed by others, as they probably will be, seem to indicate that the disease is to be regarded as a general infection with a marked tendency to localize in the meninges, and that the demonstrations of the organisms in the nasal secretions do not mean that this is the portal of entry, but possibly the site of excretion.

The Cultivation of the Meningococcus from the Blood. Baeslack, Bunce, Brunelle, Fleming, Klugh, McLean and Salomon⁶⁴ have made a study of an epidemic of the disease at Camp Jackson, Columbia, S. C., and of 25 undoubted cases they found the organism could be obtained from the blood in 36.3 per cent., from which they conclude that the systemic infection by the meningococcus was more frequent than was previously suspected. They also found that this systemic infection may occur without appreciable, or with no, meningeal localization, and that the infection may be previous to, or co-existent with, meningeal involvement. Perhaps the most important practical point in connection with these studies is that if the meningococcus is found in the blood in any number of cases, the administration of antimeningococcic serum is a rational procedure and is indicated in conjunction with the intraspinal treatment. The authors mentioned above insist upon this point.

Intravenous Serum Treatment of Cerebrospinal Fever. The recognition of the fact that the meningococcus may at times cause septicemia has led to increased study of this subject, and Herrick⁶⁵ has given an account of the treatment as it was carried out at Camp Jackson, South Carolina. He and his associates have worked out a method of procedure which he describes as follows:

"On admission, a patient presenting a combination of the early symp-

⁶⁴ Journal of the American Medical Association, March 9, 1918, p. 684. -

⁶⁵ Archives of Internal Medicine, April, 1918, p. 541.

toms mentioned is subjected to lumbar puncture. If the spinal fluid is cloudy, enough is removed to reduce the intraspinal pressure to an approximate normal and a less amount of serum is at once allowed to run into the spinal canal. If the spinal fluid is clear, no intraspinal injection is made. The fluid is rushed to the laboratory in a thermos container and immediately examined. Meanwhile, the patient receives a desensitizing dose to determine sensitiveness. One hour later 50 to 120 c.c. are administered by the vein, the first 15 c.c. at the rate of 1 c.c. per minute. Large glass syringes are best for this, as the flow is easily controlled and a cumbersome arrangement of tubes and stopcocks is not necessary. In a case of ordinary severity, this intravenous dose is repeated every twelve hours until the temperature becomes normal, or until six or eight injections have been given. In severe cases the serum is repeated every eight hours until the desired results are obtained. In fact, the size and frequency of intravenous doses are very like those advised by the group of workers in the Rockefeller Institute in lobar pneumonia of the appropriate type.

We have seen no ill-effects from these large amounts of meningococcus antiserum. In a retrospect of the epidemic, our regrets are that so many cases received doses too small."

If meningitis develops, the usual intraspinal injections are given, repeated about once in every twenty-four hours for a varying number of days until the organism has disappeared from the spinal fluid and lymphocytes make their appearance in large numbers. Herrick found that with large intravenous injections of serum the meningococci would disappear from the fluid in twenty-four to forty-eight hours, and that repeated intraspinal injections would not seem necessary. He warns against the possibility of overdoing this treatment, and notes that in some of the prolonged cases, even when the meningococci persist in the spinal fluid, they do better and may recover more promptly when all treatment has stopped.

A Positive Intracutaneous Reaction in Meningococcus Carriers. Gay and Minaker⁶⁶ have made a limited series of observations with an intradermal test very similar to the typhoidin test. The preparation used, for which the name "meningococcin" is suggested, is made up of pure cultures of five of the six strains shown as representative of the meningococcus group by Amoss. Growths on 1 per cent. agar without peptone were used, the culture being suspended in sterile salt solution and then mixed with three volumes of absolute alcohol and the bacteria separated by centrifugalization. The bacteria were then shaken up in absolute alcohol, recentrifugalized, the excess of alcohol removed and the bacteria suspended in ether. After being put again through the centrifuge, the sediment was dried for two days in partial vacuum over sulphuric acid. The resulting sediment was ground to a very fine powder and then dried again for twenty-four hours, and then suspended again in normal salt solution to which 0.5 per cent. of phenol was added.

The dose of this used in the intradermal is a volume of 0.05 c.c.

⁶⁶ Journal of the American Medical Association, January 26, 1918, p. 215.

containing $\frac{1}{150}$ mg. of the dried powder. This is injected with a fine gauge needle into, not under, the skin. Readings of the reaction were made at the six, twenty-eight and forty-eight-hour periods. The reaction consisted of a well-demarcated areola of from 3 to 7 mm. which is distinctly indurated, and most marked at the twenty-four to twenty-eight hour period, and the reaction has usually disappeared in forty-eight hours. In 31 positive carriers the intradermal test was positive in 20, or 64.5 per cent.; in 38 negative carriers, the reaction was positive in 10, or 26.4 per cent. The authors believe that further study will show whether or not this test is of practical value in dealing with meningococcus carriers. Minaker has previously shown that the usual tests for antibodies, agglutinins, fixation antibodies, yield no results of significance in positive meningococcus carriers.

Mixed Infection Meningitis. There have been a number of reports of the association of the meningococcus and pneumococcus in meningitis. Netter and Salanier, in 1917, studied the association as it occurs in children, and Mathers, in the same year, reported a case in an infant. Fitzgerald⁶⁷ has reported 3 cases occurring in a series of 12 cases of cerebrospinal fever. Gordon, in a personal communication to the last-named author, states that it is highly probable that ordinarily 5 per cent. of the cases of cerebrospinal fever are so complicating. This report is of particular interest in that it emphasizes the necessity of a careful study of the cerebrospinal fluid in all cases of meningitis, but not to assume that a cloudy fluid is necessarily due to the meningococcus alone.

Another article on the same subject and emphasizing the same lesson is one by Condat.⁶⁸ He has collected 47 instances of meningitis, some due to the meningococcus, some to the pneumococcus and to other organisms. Her cases were not mixed infections, but emphasize the necessity for determining the type of organism present.

Rapid Method for the Identification of Meningococci. The efforts made to prevent the spread of meningitis in the army camps have led to an extensive study of the methods by which the organism from the nasopharynx may be identified quickly. Olitsky⁶⁹ proposes to employ a fluid medium which serves to eliminate the organisms that resemble meningococci within twelve hours, and to reduce the full time required to identify the latter by at least one day. The advantage of his method is the sparing of the culture medium, the rapid growth of organisms in small volume of medium, which permits the negative and suspected growths to be eliminated in about twelve hours' time; the use of normal horse serum which eliminates a variety of Gram-negative micrococci; the sharpness and rapidity of the reaction of agglutination and the yielding of pure cultures of the meningococcus. His method, in his own language, is as follows:

"To 1 per cent. glucose broth (made from veal infusion and having an acidity of from 0.5 to 0.7+ phenolphthalein) is added 5 per cent.

⁶⁷ Journal of the American Medical Association, September 21, 1918, p. 969.

⁶⁸ Archives de Médecine des Enfants, September, 1918, p. 449.

⁶⁹ Journal of the American Medical Association, January 19, 1918, p. 153.

of unheated, sterile, clear normal horse serum. This medium is then distributed in small tubes (from 8 to 10 mm. in diameter and 9 cm. in length), 1 c.c. being placed in each tube.

Suspicious colonies on the plate cultures are fished and seeded, a colony to each tube.

These small tubes are then incubated twelve hours (or overnight, if more convenient). At the expiration of this time, they will show the distinctive characters of the organism in question, and at this early period 'negatives' may be determined.

The bacteria that complicate the isolation and identification of the meningococcus on plate culture are the *Micrococcus flavus*, *crassus*, *pharyngis-siccus* and *catarrhalis*; the *Bacillus influenzae*, and an unclassified Gram-positive bacillus; and occasionally, in the hands of beginners, the staphylococci and streptococci.

Owing to the presence of normal horse serum in the medium, practically a normal horse serum control is at hand, so that the *Micrococcus flavus*, *crassus* and *pharyngis-siccus*, and the unclassified Gram-positive bacillus will show firm agglutination. While the bacillus culture may show slight turbidity over an agglutinated sediment, the diplococci cultures show clear supernatant fluid over agglutinated masses of those organisms. As hemoglobin is absent, *Bacillus influenzae* fails to grow. *Micrococcus catarrhalis* grows with a dense turbidity, and often shows a pellicle on the surface. The Gram-positive staphylococci grow also with a dense turbidity, and show agglutinated masses in the sediment and often a surface pellicle as well. The streptococci grow with clear or turbid supernatant fluid, but show an agglutinated sediment.

The meningococci, on the other hand, grow in a characteristic manner. The fluid becomes faintly turbid, and a slight sediment forms; but, and this is all-important, the sediment emulsifies uniformly when the tube is shaken.

The cultures in the fluid medium are divided into two sets by simple inspection. One set is readily excluded from being meningococci on the basis of the characters described above. The other set, which exhibits the qualities of the growth of the meningococcus, is regarded as suspicious, and to each of the tubes is added 0.1 c.c. of a 1 to 10 dilution in 0.85 per cent. saline solution of a high-titer polyvalent antimeningococcic serum. The tubes are then incubated in a water-bath (not in an incubator) at from 37° to 38° C. for two hours.

The reading of the tubes is definite and distinct. Those containing meningococci exhibit distinct agglutination; those containing other organisms remain unchanged. The readings are checked by means of films stained by Gram's method. All the tubes recorded as positive will show agglutinated masses of Gram-negative diplococci of typical meningococcus morphology.

From the tubes containing the agglutinated meningococci, transplants on solid mediums may be prepared for further identification or for stock cultures. The last procedure is not necessary in order to detect or exclude the suspected meningococcus carriers."

Meningococcus Carriers. Mathers and Herrold⁷⁰ have made some studies on this subject and the bacteriology of cerebrospinal fever in one of the large military camps. Examinations were made on more than 15,000 men and a number of meningococcus carriers were identified. Cultures made on plain blood agar were found to be satisfactory, and material for the cultures obtained from the nasopharynx by means of a simple uncovered wire swab. It was found that 3.6 per cent. of the men examined were meningococcus carriers, and the majority of these were of the temporary type, but only 1.2 per cent. of the total number of suspects proved to be chronic carriers. These chronic carriers often have great numbers of meningococci in the secretions of the nose and throat. The number of carriers were particularly marked in individuals who had come in contact with meningitis cases.

The biological study of 150 strains of meningococci from different sources was differentiated by means of macroscopic agglutination tests using monovalent serums. Atypical and inagglutinable strains were met with in each group, but these did not differ sufficiently from other members of the group to warrant a separate classification as determined by agglutination. The biological type of meningococcus predominant in the camp epidemic was found to be identical with the type prevailing among the chronic carriers, but different from the type of meningococcus causing sporadic cases of cerebrospinal fever in Chicago. That there is a close relationship between the cerebrospinal fever and meningococcus carriers is shown by the fact that the same type was found in carriers and in immediate contacts in every instance.

Meningitis in the Newborn and in Early Infancy. Barron⁷¹ has made a study of this subject, based on the literature, and added a case of his own. The disease in young infants is rare. Barron was only able to find 39 cases under three months of age, and, of these, 19 were in the newborn. One of the most important contributions to this subject is the article of Koplik, which I reviewed in *PROGRESSIVE MEDICINE* for March, 1917. His study included 9 hospital cases and 3 in private practice. In older children the tubercle bacillus is the most frequent cause of meningitis and next to that the meningococcus, but in the newborn, and infants under three months of age, the bacteriology is quite different. The etiology of the 19 newborn cases shows 7 due to the colon bacillus, 6 due to the streptococcus and staphylococcus, 2 to the pneumococcus, and one each to the meningococcus, *Bacillus mucosus capsulatus*, *Bacillus lactis aërogenes* and *Bacillus pyocyaneus*. Comparing this with the total 42 cases, we find that there were 14 due to the colon bacillus, 10 to the streptococcus and staphylococcus, 5 to the meningococcus, 4 to the pneumococcus, 3 to tuberculosis, and one each to the *Bacillus mucosus capsulatus*, *Bacillus influenzae*, typhus bacillus, *Bacillus lactis aërogenes*, *Bacillus pyocyaneus*, and a doubtful case due to the *Bacillus catarrhalis*. The route of infection was not clear in most instances. A great many of the cases due to the staphylococcus and streptococcus have been caused by a spina bifida. In the others it is

⁷⁰ *Journal of Infectious Diseases*, 1918, xxii, p. 523.

⁷¹ *American Journal of the Medical Sciences*, September, 1918, p. 358.

possible the infection may have taken place through the mouth by means of fingers or instruments, and it is possible that infection may have occurred in the bathtub through the water having become contaminated. The external auditory canal is also thought to be an important avenue for infection in the infant, and 3 of the cases reported by Sherer were thought to have entered through this route.

Mumps. Radin⁷² has made a report on an epidemic of this disease that occurred at Camp Wheeler, Georgia. One does not ordinarily consider mumps as seriously as it should be, but this particular epidemic it is estimated cost the Government at least \$1,000,000. Out of approximately 18,000 men, there were 5756 cases, or an incidence of 32 per cent., or about every third man in the division had the disease. During the epidemic the total admissions to the hospital were 13,638—42.2 per cent. of which were cases of mumps. Some few negative observations were made on the etiology, but apparently no notice was taken of the previous work of Wollstein on this subject. One reason for the large morbidity was the fact that most of the men lived on farms nearly all their lives and so had escaped the disease earlier in life.

Hathcock has described a diagnostic prodromal sign, which he regarded as pathogenic. This consists of tenderness just along the angle of the jaw on running the finger toward the angle, under the mandible. If the parotid gland is involved the patient winces with pain, and this occurs before any swelling can be made out. Radin suggests that this be noted in the literature as Hathcock's sign, stating that it is constant, it is early, it is definite and it is exclusive, therefore it is diagnostic. He gives it the same importance that Koplik's spots bear to measles.

About 200 of the cases were studied by Belding with reference to the blood. The uncomplicated cases showed approximately a normal total leukocyte count (7060). In orchitis there was found to be a definite leukocytosis (10,730) which was largely polymorphonuclear in character, being about double the number of leukocytes found in the uncomplicated cases, and in these cases there was an increase in the number of lymphocytes as well.

In the prophylaxis, careful isolation of cases for a period of three weeks is recommended. The use of hexamethylenamin, 5 grains four times daily, was tried on alternate patients with a view of preventing orchitis, but was found to have no appreciable effect, according to Hathcock's figures, but Radin believes that taking the patient who had the drug before the complication developed, there was a reduction in the number by 33 per cent.

Pappataci, or Phlebotomous, Fever. In previous numbers of PROGRESSIVE MEDICINE I have made short notes on this disease, which is mild and has comparatively little import except as a factor in disturbing the health of soldiers. The disease is transmitted by the Pappataci or sand-fly. This little fly flies by both day and night, and generally produces small, irritable papules. Among the other notes on the disease are those by Hartley⁷³ and Delmege and Staddon.⁷⁴

⁷² Archives of Internal Medicine, September, 1918, xxii, p. 354.

⁷³ British Medical Journal, April 6, 1918, p. 395.

⁷⁴ Ibid., p. 396.

The incubation period varies from four to six days and is marked by malaise and irritability of temper. This is usually followed by a sudden onset with slight shivering, sometimes fever and usually a slight nasal catarrh lasting for a day or two. The patient suffers with a severe headache, usually either frontal or postorbital, some backache and pains in the extremities, and there is loss of appetite and often vague abdominal discomfort. The face is flushed and the conjunctivæ are injected and the eyeballs usually tender on palpation. In many instances there is a slow pulse-rate, but a sudden rise of temperature, usually to 102° to 103° for thirty-six hours and occasionally higher than this. As a rule, the temperature falls below normal and remains subnormal for several days, but there may be a subsequent rise after a day or two, and occasionally irregular fever lasting a week or so. The slow pulse generally persists for four or five days after the temperature drops and most of the symptoms disappear with the disappearance of the fever. Reinfections are not very frequent, but Delmege and Staddon noted some, and in all instances these were milder than the first attack. The foregoing account of the disease is taken from their description of it as it occurred in Macedonia. They noted the greater preponderance of critical falls of temperature over those falling by lysis as found in the other accounts of the disease, and also had a greater frequency of postcritical rises of temperature.

The Leptothrix of Parinaud's Conjunctivitis. In 1889, Parinaud described a chronic conjunctivitis which was characterized by the unilateral development of nodules beneath the conjunctivæ, and involvement of the corresponding pre-auricular gland. The etiology of this condition was obscure until, in 1913, Verhoeff published his study of 12 consecutive cases, in 11 of which he found this same minute filamentous organism. The histological picture in all was the same. The organisms were found in irregular masses, from 10 to 60 microns in diameter, either near or within the areas of cell necrosis, and could also be demonstrated in the superficial lymph spaces which accounts for the involvement of the regional nodes. The filaments are very slender, about the diameter of the influenza bacillus, and varied from a few microns to 30 microns in length. They were stained with difficulty and could be demonstrated with a modified Gram stain. There was no branching in Verhoeff's cultures; the organism was provisionally classed as a leptothrix.

Wherry and Ray⁷⁵ have found a similar organism, and pus from the pre-auricular gland injected subcutaneously into a white mouse produced an infection, after an incubation period of four or five days, characterized by purulent conjunctivitis and death. The leptothrix was isolated from muscular abscesses and a similar organism was isolated from a human case from material taken directly from the pre-auricular gland. This organism resembled that described by Verhoeff, except that it was not granular. In Verhoeff's organisms there were regularly distributed granulations of variable size and they were never exactly centered in the axis of the filament, but projected noticeably above its surface.

⁷⁵ Journal of Infectious Diseases, 1918, xxii, p. 554.

The Value of Vaccines in Pertussis. There is a very considerable difference of opinion on this subject at the present time, and a very considerable amount of further observation will have to be made before the value of the pertussis vaccine can definitely be determined. Hess, several years ago, was of the opinion that the vaccine did not seem to be of value in curing the disease or lessening its severity, but he thought it did have some prophylactic value as in a large number of children given prophylactic injections, only 20 developed the disease. More recently, in the same institution, Barenberg⁷⁶ has had an opportunity of observing the effect. The cases that he considers may be divided into five groups:

1. Early prophylactic treatment.
2. Later prophylactic treatment.
3. Unvaccinated.
4. Curative vaccination.

5. Patients who had received prophylactic treatment in 1915 as well as curative or prophylactic treatment in the epidemic in question.

In the first class of cases it is almost always difficult to be sure the child has not been infected before the prophylactic injection has been undertaken. Barenberg was fortunate enough to have 41 children in isolation, and they were given a series of treatment for three weeks before they were transferred to the main building where the epidemic broke out. Seventy per cent. of these did not develop the disease, while most of those that did develop it had it in a mild form, although 3 are set down as being severe, with an average duration of nine weeks.

In the second group of later prophylactic treatment, there were 220 children who were unavoidably exposed to infection and they were vaccinated as those before mentioned, and of this number 114 developed pertussis from two to twelve weeks after vaccination. Of these, the reports states it was mild.

There were 18 children who did not receive any treatment and 9 contracted the disease, and one-third followed a mild course.

Some of the children received three injections, some of the more severe being given four, the last two consisting of two billion bacteria. The results in these were not particularly satisfactory and Barenberg is led to about the same conclusions which Hess reached in 1915. He is of the opinion that even in large doses the vaccine has no curative effect and does not tend to lessen the severity of the disease. He does believe that as a prophylactic it has some very definite value.

Huenekens⁷⁷ has had some experiences on this subject in which the results were controlled by complement-fixation tests. He concludes that pertussis vaccine from two to three months old employed in very large doses, that is, one billion and over, immunizes only about 12½ per cent. of cases, but when the vaccine is not so old, that is, two to four weeks, it confers an immunity in from 25 to 75 per cent. of cases, whereas freshly prepared vaccine, employed in the same dosage, gives antibody formation in 94 per cent. of cases. When used in still larger doses, one and a half and two billion, 100 per cent. positive reactions are obtained.

⁷⁶ American Journal of Diseases of Children, July, 1918, p. 23.

⁷⁷ Ibid., p. 30.

The antibodies may be demonstrated one week after the injection. He is of the opinion that to be of any value it should be employed when very fresh and without any preservative, and by fresh vaccine he means a vaccine less than one week old. He is also of the opinion that one and a half and two billion should be given on alternate days for three doses. It should be of great value in the early catarrhal stage of the disease. Of course, this point can only be decided by actual observation on cases. He advised that the vaccine be used on doubtful cases without waiting to confirm the diagnosis.

Pneumonia. ACUTE LOBAR PNEUMONIA. Shattuck and Lawrence⁷⁸ have made a study of some 4000 odd cases of lobar pneumonia treated at the Massachusetts General Hospital from 1822 to 1917, inclusive. There has been a gradual increase in the death-rate which in the first decade was 10 per cent. and which was changed to 28 per cent. at the present time, but there has been no significant change in the rates since 1881. Curiously enough, the cases classed as delicate or intemperate have been decreasing during the same period. One possible explanation of the increase in complicated cases is probably due to the increased accuracy of diagnosis and recording. The relative number of foreign-born patients is increasing, while the death-rate is decreased. The death-rate among the American-born is increasing slightly as there has been also an increase among the men as compared with women. This may be due to a corresponding increase in vascular diseases during the period studied. The treatment used has varied with the period, but the rate has been practically the same whether they were bled, purged or given fresh air, and the authors state that until a specific is discovered which will neutralize the toxins of the pneumococcus, one can scarcely hope for any drop in the mortality. The results from the use of serum are apparently favorable, but are as yet too limited to draw any very definite conclusions.

Their figures showing the effect of alcohol are very interesting. When used habitually during health in more than moderate amounts, the patient's chances for recovery are diminished, but the mortality rate among those patients who are given large amounts of alcohol during their illness is no higher than among those given no alcohol and large amounts of fresh air. The figures suggest that alcohol is not harmful to those sick with pneumonia and that the effect of the drug varies with the condition under which it is given and it is not injurious to those having high temperatures and taking insufficient nourishment.

An interesting unsigned review of the prevention and treatment of pneumonia which covers the range of our present knowledge of the subject and which should be consulted by those interested will be found in the *Journal of the American Medical Association*, Feb. 9, 1918, p. 382.

THE IMPORTANCE OF BLOOD CULTURES IN PNEUMONIA. McClelland⁷⁹ has an interesting study on this subject. Cultures were made by withdrawing from 15 to 20 c.c. of blood into a sterile syringe and putting 10 to 15 c.c. of this in a flask containing from 100 to 150 c.c. of plain

⁷⁸ Boston Medical and Surgical Journal, Februray 21, 1918, p. 245.

⁷⁹ Journal of the American Medical Association, October 19, 1918, p. 1299.

meat infusion broth and the remainder plated in agar. McClelland believes that blood cultures in pneumonia are of value from the standpoint of prognosis and as a guide in the serum therapy of Type I cases. Organisms are to be found in the blood most commonly in the more virulent strains and with the *Streptococcus hemolyticus*, but when Type I pneumococcus septicemia was found the patient responded promptly to treatment by the immune serum, and also Type IV pneumococcus septicemia may be quickly recovered from. If, however, the hemolytic streptococcus is found, the prognosis is bad, and in McClelland's experience in a limited number of cases, all except one having this infection died.

THE USE OF RABBITS IN PLACE OF WHITE MICE IN PNEUMOCOCCUS TYPE DIFFERENTIATION. Faber⁸⁰ suggests that inasmuch as rabbits are very susceptible to pneumococcus infection they may be used in place of white mice and he has done this successfully in 15 instances. The Rockefeller technic of preparation and injection of sputum was followed, except that about three times as much was used as for mice. The age and size of the rabbits did not seem to make any difference, but Faber reserves his final opinion on this subject. Rabbits as small as 600 gm. and as large as 3500 gm. have been used and also as young as two weeks. In case of the absence of white mice, the rabbits may be of considerable value.

THE PREVENTION OF PNEUMONIA. Cole⁸¹ calls attention to some of the points in regard to the prevention of this disease which may occur endemically or in epidemics. The acute lobar pneumonia, which is an endemic disease, is due to the pneumococcus, while the epidemic bronchopneumonias are chiefly due to various forms of streptococci. Theobald Smith has pointed out that streptococcus infections in animals are not self-perpetuating, but that they occur in epidemics, usually secondary and not primary infections. This is also true in man. When an epidemic of bronchopneumonia starts, efforts should be made to limit its spread at once, for each case, as Cole points out, not only serves to add to the extent of the disease but also increases the intensity of the virulence of the organism. After the disease is more or less widespread, the prevention of it is a matter of extreme difficulty. I have referred to the experience at Camp Upton with regard to the pneumococcus form and the use of the vaccine in another place in this review. In regard to the streptococcus pneumonias the problem is difficult, and Cole believes that persons who harbor large numbers of actively hemolytic streptococci in the throat may be regarded as potential carriers of the disease. Just how long these organisms persist outside the body is not definitely known, but it seems to be a fact that they resist drying and unfavorable influences. One should also bear in mind the possibility of the disease being spread through foods, particularly milk. Most of the cases occur from direct transfers from cases of the disease or from a healthy carrier to the individual contracting it, either by droplet infection or by streptococci being carried in particles of dust. While

⁸⁰ Journal of the American Medical Association, May 18, 1918, p. 1459.

⁸¹ Ibid., August 24, 1918, p. 635.

these organisms apparently do not have a predilection to invade man, when they do they may produce a very grave infection owing to the rapidly increased virulence and, as in the recent epidemics, the mortality may be exceedingly high.

To prevent the disease, Cole suggests that inasmuch as many of the epidemics start after, or coincident with, epidemics of measles, special measures should be taken in institutions to prevent the infection of individuals with a high degree of susceptibility, that is, those with measles, bronchopneumonia and other respiratory infections. Secondly, to make a diagnosis of the presence of the disease as early as possible and to insist on rigid isolation. He does not comment on the use of the face mask, the value of which is noted in another place.

Chemicals in Prophylaxis. Kolmer and Steinfield⁸² made a contribution to this subject. The investigations of Morgenroth and Levy, Wright, Moore, Cohen, Kolmer and Heist have shown that ethylhydrocuprein, as well as other cinchonæ compounds, has definite germicidal properties for pneumococci. Following out this idea they found that a solution of 1 to 10,000 of ethylhydrocuprein hydrochloride or quinine bisulphate in 1 to 10 liquor thymolis might destroy the virulent pneumococci in the mucous membrane of the mouth and upper part of the throat, or, at any rate, lessen their proliferation in large quantities, and they recommend its use in physicians, nurses and persons in the family who may be in intimate contact with persons suffering with lobar pneumonia, with a view of lessening the incidence of the disease.

Vaccines in Prophylaxis. Some interesting observations have been made by F. S. Lister, working under the South African Institute for Medical Research on the subject of the immunity of man against infection with the pneumococcus. These studies were undertaken with particular reference to the native mine laborers. It is well known that the negro is particularly liable to have lobar pneumonia, especially those in laborers' camps, and the Rand and other mines have had great difficulty in the past in dealing not only with the disease, but with epidemics of it. Sometimes the infection is particularly liable to produce a meningitis, as is shown by the work of Baujean.⁸³ He also describes some cases of pneumococcus infections of the skin; of 6 cases, 4 were on the face, and the general appearance was that of an erysipelas, with a large amount of edema and swelling. Small bullæ were noted in successive crops and were sometimes small abscesses which were full of the organism.

Pneumonia in the negro is also particularly fatal, especially in laborers' camps, and Jouin⁸⁴ has commented upon the number of sudden deaths occurring in the first few days, apparently due to changes in the cardiac nerves, but clinically the heart is free from murmurs, but rapid, and the blood-pressure low, often below 100 mm.

Lister's work may, perhaps, be said to be an outgrowth of that begun in 1912 by Wright, who inoculated the laborers in the Rand mine and successfully, for there was a fall in the disease. At that time the classi-

⁸² Journal of Infectious Diseases, March, 1918, p. 220.

⁸³ Bull. Soc. de Path. Exotique, Paris, 1917, x, p. 816.

⁸⁴ Ibid., p. 774.

fication of the pneumococcus into distinct groups had not been made. In America, the four chief groups are described, which I discussed in *PROGRESSIVE MEDICINE* last year. These are known as I, II, III and IV, the most frequent cause being group I, for which a fairly satisfactory serum has been produced, while group II has not yielded a satisfactory serum; group III cases in America are the severest and usually fatal forms of pneumonia, and group IV represents all of the other specimens of the organism which do not group themselves under the first three.

Lister has isolated about a dozen which he has designated by letters. Of these, what he calls A, B and C are responsible for 69 per cent. of the cases of pneumonia in the Transvaal natives. The group A apparently is not found as a factor of pneumonia in America, while his group C corresponds to the American type I and his B to the American type II. It is unfortunate that he could not have seen his way clear to adopt a similar grouping to that adopted by Dochez and Gillespie and Cole. He used a vaccine made of his A, B and C groups, and the natives working in the Crown mines became immune to pneumonia as caused by these organisms, although pulmonary inflammations due to these groups were common enough in the uninoculated negroes. Some cases of pneumonia due to other groups occurred in the negroes who had been given the vaccine, but these were not very numerous, and were due to organisms belonging to other groups, what Lister names E, H, J and K.

Cecil and Austin⁸⁵ have made some studies along the same line, the importance of which is readily apparent when one considers that 80 per cent. of the deaths in the various training camps in this country have been due to pneumonia, and in spite of the fact that the streptococcus has been the causative agent in many cases, the pneumococcus has also played an important part. It has been shown by animal observation that the injection of small doses of organisms will produce an active immunity, even in very susceptible animals, as the mouse and the rabbit, and that this immunity persists for a considerable time. Without going into the details of the observations of Cecil and Austin, they determined that from a study of the agglutinins and protective power of the serum, 42 persons vaccinated against the pneumococcus, types I, II and III, a definite immunity response was noted with a vaccine of types I and II, but there was little evidence of response to type III. The reaction to the vaccination seems to depend upon the total dosage of each type of organism administered. Some response could be elicited by two and a half billion cocci of each type, but the results were constant and greater when thirteen billion were used. When the organisms are injected subcutaneously the manner of administration, as to whether given in a single large dose or in seven small daily doses, or in three to five moderate doses at three- to seven-day intervals, seems to have little influence upon the degree of immune response, provided the total dosage is the same. The local and general reactions varied greatly in different individuals, and as the amount of reaction was less when the individual dose is small, it seems that it is

⁸⁵ *Journal of Experimental Medicine*, July, 1918, p. 19.

desirable to divide the total dosage into as many doses as the circumstances made practicable.

At Camp Upton, 12,519 men were vaccinated against types I, II, and III, three or four doses being given at intervals of five to seven days, with a total dosage of six to nine billion of types II and III, and four and a half to six billion of type III, and during the ten weeks that have elapsed since the vaccination there have been no cases of these types among the men who have received doses of the vaccines. In approximately 20,000 men who were used as controls, there were 26 cases of pneumonia due to types I, II and III. It was also found that the incidence of pneumonia due to type IV and streptococcus pneumonia was much less in those that had been vaccinated than in those who had not.

The authors do not advance any explanation for this fact. In some individuals local reactions occurred, consisting of small sterile infiltrations which disappeared spontaneously and which seemed to be due to hypersusceptibility of the skin, and when this reaction occurred it was found after each injection. These same individuals gave abnormally marked reactions to intradermal injections of pneumotoxin, but they did not show any notable change in the amount of general response. This reaction is not typical of any particular type, and type III did not cause it any more frequently or severely than types I and II.

THE CHEMOTHERAPY OF EXPERIMENTAL PNEUMOCOCCUS INFECTION. Kolmer and Steinfeld⁸⁶ have continued their observations on this subject and have found that the ordinary soluble salts of mercury and numerous new mercurial compounds have no appreciable effect in prolonging the lives of mice infected with a lethal dose of type I pneumococcus sufficient to produce death in seventy-two hours. They believe that systematic researches along the same line will eventually yield results of very decided value in the treatment of bacterial infection in general and of the pneumococcus infections in particular. As a result of their experiments, they believe that derivatives of quinine will probably be found to be the drug of greatest value. They found that subcutaneous injections of ethylhydrocuprein hydrochloride in doses without protective value, usually increase the value of antipneumococcus serum type I in a very definite manner, and in some of the commoner compounds, such as quinine and urea hydrochloride, quinine bromide and quinine chlorohydrosulphate administered subcutaneously in doses such as usually have no appreciable influence on severe and fatal pneumococcus infections occasionally increase the protective power to a lesser extent and less regularly than ethylhydrocuprein hydrochloride.

ETHYLHYDROCUPREIN IN ACUTE LOBAR PNEUMONIA. Moore and Chesney⁸⁷ have published a second article on this subject, the first of which I reviewed last year. In the present article they come to the conclusion that ethylhydrocuprein (optochin) base is absorbed with difficulty into the blood stream from the gastro-intestinal tract, but that the hydrochloride is easily absorbed. They also demonstrated that pneumococci in the human body may become resistant to the action

⁸⁶ *Journal of Infectious Diseases*, 1918, xxii, p. 492.

⁸⁷ *Archives of Internal Medicine*, 1918, xxi, p. 659.

of this drug during the treatment. They also were able to demonstrate that the pericardial fluid that had been obtained at postmortem from persons treated with ethylhydrocuprein hydrochloride showed pneumococidal power, and in one instance the serum from a patient who had been given a very large dose of the drug intramuscularly showed a similar power.

The eye symptoms that are encountered in the use of this drug are a decided drawback. In Moore and Chesney's experiences of 75 cases, 9, or 12 per cent., showed some degree of amblyopia. This was mild in 3 and more severe in 6, but in all those who recovered from the pneumonia the eye symptoms disappeared completely after the cessation of the administration of the drug. They are led to the conclusion, from their observations on 75 cases of acute lobar pneumonia due to pneumococci, that the use of ethylhydrocuprein did not lead to any noteworthy therapeutic benefit, and they do not recommend its routine use in the disease. The reason for this failure they attribute to the fact that it is impossible to administer a sufficient amount of the drug to produce an effective concentration in the blood stream without at the same time exposing the patient to the danger of its toxic action. In the concentrations which may be obtained in the blood with any degree of safety the pneumococidal action is too slow and the organisms may gain access to the surrounding blood at a greater rate than they are destroyed even though the serum shows no pneumococidal action. They also demonstrated that in the concentrations that are safely attained in the body fluids, the drug probably penetrates but poorly into the alveolar exudate.

THE TREATMENT OF INFLUENZA PNEUMONIA BY THE USE OF CONVALESCENT HUMAN SERUM. A preliminary report on this subject has been made by McGuire and Redden.⁸⁸ Convalescent patients were bled as soon as convalescence was well established, in the majority a week or ten days after the temperature had returned to normal. The dose varied from 75 to 125 c.c., given intravenously, and the interval between the doses from eight to sixteen hours. Efforts were made to start the treatment as soon as the diagnosis was made and to continue it until there was no doubt about the recovery of the patient. Most of the cases received 300 c.c., but 3 received only 100 c.c., while 2 were given from 600 to 700 c.c. It was found that there was a marked difference in the degree of potency in the convalescent serum. At least ten out of seventy serums had no effect on patients. When this happened, succeeding doses from other patients were used. Results were usually noted in the first twenty-four hours, and if some effect was not obtained by this time the serum from another donor was used.

In all cases the Wassermann test was made on the donor, and compatibility tests with the serum were made as soon as new cases appeared in the ward. At the time of the report, 37 patients had been treated. Of this group, 30 were convalescent, 6 were under treatment and 1 had died. All but 1 under treatment had a favorable outlook. Comparing

⁸⁸ Journal of the American Medical Association, October 19, 1918, p. 1311.

these figures with the untreated cases in which the mortality was as high as 50 to 60 per cent. and later dropped to 30 per cent., it would seem that this serum had a definite value. Unfortunately, at present there is no way to test the potency of it except by clinical use.

ANTIPNEUMOCOCCUS SERUM IN THE TREATMENT OF LOBAR PNEUMONIA. Kyes⁸⁹ has reported some observations on this subject in which an antipneumococcus serum was used which had been produced in fowls. The technic of obtaining this serum was first described by Kyes⁹⁰ in 1911, and was produced by injecting massive doses of virulent pneumococci into the domestic fowl. The pneumococci used had been obtained from the blood stream or the lung of an individual suffering from acute lobar pneumonia. The injections were made intraperitoneally every other week for a period of from four months to two years. The serum was obtained by bleeding once in two weeks, the week of bleeding alternating with that of injection. The serum so obtained was said to have a high content of antibodies specific for pneumococci, as demonstrated in their agglutinating and lytic power, their bactericidal properties and their therapeutic action upon infected animals.

Out of 115 cases of lobar pneumonia treated with the serum, 24 died, a death-rate of 20.8 per cent. These figures may be compared with 538 cases not treated, of which 244 died, a death-rate of 45.3 per cent. In the ward in which the serum was employed the death-rate during the six weeks prior to the serum treatment was 55 per cent., and during the six weeks subsequent to the treatment the death-rate was 51 per cent. Kyes believes that this proves that his serum is of very distinct value in the treatment of acute lobar pneumonia in man.

THE POTENCY OF ANTIPNEUMOCOCCUS SERUM. Wayson and McCoy⁹¹ tested 104 lots of antipneumococcus serum, using animal tests after the method of Neufeld, as modified by Cole. This consists of inoculating mice with a fixed dose of serum and varying the dose of culture. Both the serum and the culture are injected into the peritoneal cavity. The tests showed that there is apparently no inherent difficulty in the production of antipneumococcus serum on a commercial basis, and it was found that the serums now available on the market are of as high a potency as those produced in laboratories that are now engaged in the sale of the product.

PARTIALLY AUTOLYZED PNEUMOCOCCI IN THE TREATMENT OF PNEUMONIA. E. C. Rosenow⁹² calls attention to the fact that the curative power of the antipneumococcus serum in lobar pneumonia due to type I appears to be established, and that the heat-killed virulent pneumococci may be used to stimulate the formation of antibodies has been demonstrated by Wolf.⁹³ These antibodies tend to protect animals against pneumococcus infections. Others have used soluble substances derived from the killed pneumococci in small series of lobar pneumonia. Rosenow has prepared an antigen or vaccine by growing virulent strains of

⁸⁹ Journal of Medical Research, July, 1918, xxxviii, p. 495.

⁹⁰ Journal of the American Medical Association, June 24, 1911, lvi, 1878.

⁹¹ Ibid., June 8, 1918, p. 1747.

⁹² Ibid., March 16, 1918, p. 759.

⁹³ Journal of Infectious Diseases, 1906, p. 731.

the organism in tall columns of glucose broth. After eighteen to twenty-four hours the cultures are centrifugalized and the sediments suspended in salt solution so that 1 c.c. contains the growth from approximately 15 c.c. of the culture, or about fifteen billion pneumococci per cubic centimeter. These were placed in tall bottles and 0.5 c.c. of ether added, thoroughly shaken and kept at a temperature of 37° C. The suspension is thoroughly shaken at least twice a day. Autolysis is carried to the point at which 95 per cent. of the organisms have become Gram-negative and to the point at which 5 c.c. of the suspension produce no symptoms in guinea-pigs weighing from 250 to 300 grams. In highly virulent strains, this stage may be reached in from three to five days. The ether is then removed, and 0.25 per cent. cresol or phenol added. This is then tested in guinea-pigs which must remain well for at least ten days and the cultures remain sterile during that time. Of this antigen, 1 c.c. may be used for adults and for children from 0.25 c.c. upward, depending on the age. It may be administered daily until the temperature becomes normal and remains so for one or two days.

This antigen was used in 200 cases, 186 of which recovered and 14 died. In the cases that recovered, 63 showed strikingly good results, and in 73 the results were given as good, and in 50 as indifferent. Rose now tells "of the 3 fatal cases in which the patients received the first injection on the second day; the apparent results were strikingly good in 1, good in 1 and indifferent in 1, while in the 11 patients who died and who received the first injection on the third day or later the apparent results were indifferent in all." This statement reminds one of the famous remark of the French physician who stated that his patient died cured. There were only a few cases in which there was a decided local reaction at the point of injection, and in no instance was the injection followed by chill and no harmful effects have been reported. Sometimes there was a rise in temperature followed by a marked drop within twelve hours.

Poliomyelitis. The United States Public Health Service⁹⁴ has issued a bulletin which includes four papers. The first of these is on the "Pathology and Pathogenesis of Myelitis," by Wayson, and includes a short bibliography of the most important contributions to this subject. The article does not contain any original work, but is merely a *resumé* of the observations and opinions of others. It makes a good introduction to the papers which follow.

EXPERIMENTAL POLIOMYELITIS. Leake made a study with material from two epidemics, one from 1916 in New York City and the other in the winter of 1916-17 in West Virginia. Portions of the human spinal cord from definite cases of poliomyelitis preserved in glycerin, were ground in small hand mortars with salt solution and injected into monkeys, 0.5 c.c. into the left cerebral hemisphere and 2 c.c. intraperitoneally. Seven specimens from New York City produced poliomyelitis in monkeys, 3 of which survived the acute attack. Of 4 specimens from New Jersey, only 1 produced a typical attack, and from this the monkey recovered.

⁹⁴ Hygienic Laboratory Bulletin, No. 111.

Of 3 specimens from West Virginia, 2 produced poliomyelitis that recovered, and 1 caused no symptoms. Attempts made to produce the disease in monkeys by injection of filtered nasal washings from human carriers were made in a few instances, but with negative results, as were attempts to produce the disease by transferring nasal secretions from sick to well monkeys. It was also interesting that healthy monkeys placed in contact with those inoculated remained well. All attempts of producing the disease by feeding the virus to monkeys were negative, but on subsequent intracranial inoculation 1 of the 2 monkeys so fed failed to develop the disease at first, but succumbed to a second inoculation after a slightly prolonged incubation period. This opens the question as to whether a partial immunity was produced by feeding the virus.

Using the filtered virus, the disease was produced in 2 out of 3 observations. Certain studies made to determine the immunity of the possible carrier by a serum neutralization test did not give very satisfactory results, and attempts to immunize monkeys which had received injections of the virus with horse serum were also unsuccessful.

OBSERVATIONS WITH MATERIAL FROM DOMESTIC ANIMALS ASSOCIATED WITH CASES OF HUMAN POLIOMYELITIS. The article quoted above contains some interesting observations dealing with animals which had manifested symptoms of a paralytic nature with the exception of a cat, and all of these came from a locality in which there was an epidemic. In most instances there had been more or less intimate association with human cases. Inoculations into healthy animals of the same species, and in some cases into monkeys, gave negative results. Histological changes showing involvement of the cord or of its membranes were found in 3 instances. One dog developed paralysis after injection of a spinal-cord emulsion, but this condition was found not to be transferable.

POLIOMYELITIS AND SMALL LABORATORY ANIMALS. Stimson, in a third article, undertook to determine whether it was possible to produce the disease in rabbits, guinea-pigs and rats, and also if paralytic conditions could be induced by use of the virus of poliomyelitis. Observations were made on the animals above mentioned, all of which were negative with the exception that in a few instances there was a paralysis found to be due to traumatic or gross conditions, but which did not correspond in any way with poliomyelitis. The failure to produce the disease in these animals was after using a technic similar to that employed by authors who have claimed to have infected various small animals, so that Stimson concludes that either the strain of virus used differed from his in its pathogenic properties, or the virus was contaminated with some organism capable of producing paralysis in small animals. I have commented so extensively on this subject in previous issues of *PROGRESSIVE MEDICINE* that it is not necessary to refer to it here.

CARRIAGE OF THE VIRUS OF POLIOMYELITIS AND SUBSEQUENT INFECTION. Taylor and Amoss⁹⁵ have reported an instance in a family containing four children, all of whom had poliomyelitis. Two of the children were proved by inoculation tests to carry the virus of polio-

⁹⁵ *Journal of Experimental Medicine*, 1917, xxvi, p. 745.

myelitis in the nasopharynx. One of these was found to be a carrier after recovery from a non-paralytic attack of the disease, and one was discovered to be a carrier five days before the appearance of the initial symptoms. The original case from which the others took origin was fatal. The youngest child, after a severe onset, was treated with immune serum and made a prompt recovery. The original case was exposed in a locality in which the disease was epidemic, and it developed after he returned home to a village in which no previous cases of the disease had occurred. Taylor and Amoss present the proposition that every case of poliomyelitis develops from a carrier of the microbic cause or virus of poliomyelitis.

ETIOLOGY OF POLIOMYELITIS. Tsen⁹⁶ has an article on this subject outlining some original investigations and giving a valuable bibliography, together with some discussion of the work of other observers. Using the Noguchi technic after many trials, he succeeded in finding organisms similar to the globoid bodies culturally, morphologically, and in staining reactions, but in some cases, which remain unexplained, it was not possible to carry the culture for more than three generations. For this reason monkeys were not injected. While the work of Flexner, Noguchi and Smillie has not received very much confirmation, their observations have not been positively disproved, but, as Tsen points out, the globoid bodies have not yet been proved to be able to produce immunity against poliomyelitis, and a series of monkeys immunized with them failed to show neutralizing power to poliomyelitic virus. Tsen was able to isolate streptococci from the central nervous system of monkeys dead of the disease and also from the central nervous system of monkeys dead from other diseases and from the brains of normal rabbits. The organisms obtained from the poliomyelitic monkeys did not differ from those from monkeys and rabbits dead from other causes. Tsen concludes, as a result of his observations, that an etiological relation has not been definitely established between streptococci and poliomyelitis.

Anyone interested in this subject will do well to read carefully his original article. He gives the following interesting table of the chief similarities between the globoid bodies and the streptococci and the poliomyelitic virus:

GLOBOID BODIES.	POLIOMYELITIC VIRUS.	STREPTOCOCCI.
"They have been found repeatedly in the lesions of poliomyelitis in man and the monkey; they have not been detected in lesions or conditions other than poliomyelitis." (Amoss.)	It has been found only in cases of poliomyelitis and in poliomyelitis carriers.	They have been found in the lesions of poliomyelitis, in the lesions of other diseases, and in normal brains and cords.
" they have sufficed to reproduce in several instances the experimental disease in monkeys." (Amoss.)	It is capable of producing typical lesions of poliomyelitis only in monkeys.	They can produce gross and microscopic changes similar to those found in acute poliomyelitis in man, not only in monkeys but also in rabbits, guinea-pigs and many other animals.

⁹⁶ Journal of Experimental Medicine, September, 1918, p. 269.

GLOBOID BODIES.	POLIOMYELITIC VIRUS.	STREPTOCOCCI.
They have not been shown to produce immunity against poliomyelitis.	It can render monkeys immune against poliomyelitis.	Rosenow, Towne and Wheeler and others have reported successful immunization of monkeys with these organisms against poliomyelitis.
"Sera of monkeys immunized with these organisms cannot neutralize poliomyelitic virus." (Amoss.)	Serum of monkeys immunized with this can neutralize the active virus.	" . . . Serum of the horse immunized with recently isolated strains from experimental poliomyelitis in the monkey appears to have developed neutralizing, protective and curative power against the virus of poliomyelitis." (Rosenow.) "But this serum has failed to show more neutralizing power against poliomyelitis virus than normal horse serum." (Amoss and Eberson.)
"The serum obtained from monkeys recovered from experimental poliomyelitis shows very little agglutination power." (Amoss.)		"The serum of patients and monkeys recovered from poliomyelitis cross-agglutinates specifically many, but not all, of the strains in the lower dilutions." (Rosenow, Towne and Wheeler.)

The Cultivation of the Globoid Bodies of Poliomyelitis. Smillie⁹⁷ has made a study of this subject with the hope of modifying the method by rendering it simpler and more certain of success. The original procedure is not only uncertain in its ultimate result but also in the number of cultures yielded by a given lot of tubes inoculated with poliomyelitic tissue. Smillie has modified the technic by the use of the hydrogen-nitrogen jar, which utilizes the catalytic action of platinized asbestos upon hydrogen and oxygen and removes all traces of oxygen from the jar. He was able to grow the globoid bodies, identical in morphological and cultural characteristics with those described by Flexner and Noguchi in twenty-two cultures from the tissues of seven monkeys suffering from experimental poliomyelitis. Twenty of the strains were cultivated from the central nervous organs, except one which was cultivated from the cervical portion of the spinal cord. Two strains were cultivated from the spleen. None of the cultivated strains inoculated produced typical poliomyelitis in monkeys. He found the streptococcus either as a contamination or a secondary invader, but nothing in his observations would lead to the belief that it has any bearing on the etiology of the disease. He found it especially in animals that had been etherized when moribund, or that had died some hours previous to the autopsy. When the infected and paralyzed animals are killed while still strong, secondary invading bacteria, including the streptococcus, tend to be absent from the tissues.

⁹⁷ Journal of Experimental Medicine, 1918, xxvii, p. 319.

Heist, Solis-Cohen and Kolmer⁹⁸ have been able to isolate these organisms from human and monkey material in four different strains. This organism resembles, morphologically and culturally, that described by Flexner and Noguchi in 1913. They also observed that the macroscopic appearance of tubes of kidney ascitic medium used for cultures were so similar in tubes containing a good growth and those containing none that they believe that the inspection of the tubes alone is of no value to determine the presence or absence of the growth.

The Streptococcus and Poliomyelitis. Rosenow and Wheeler⁹⁹ have given a description of the organism which they found in the tissues from fatal cases of poliomyelitis from different parts of the country. The organism was found in the various parts of the central nervous system, in the mesenteric lymph nodes and in large numbers in the adenoids and tonsils. They described this organism as a pleomorphic coccus with great variations in size and shape, depending on the method of cultivation. In aerobic cultures it greatly resembled the ordinary green-producing streptococci or pneumococci of low virulence. In anaerobic cultures it grows to very small size and becomes filterable and in every way appears identical with the globoid organism noted by Flexner and Noguchi. The authors state that the variations noted in the cultures have been proved not to be due to contaminations or to mixed cultures. They believe that it has an etiological relationship to poliomyelitis, and they give as their reasons for this that it is constantly present in the diseased tissues, from which it can be cultivated even many months after glycerolation. When injected into young rabbits and guinea-pigs, it localizes specifically in the nervous system and produces flaccid paralysis and changes in brain and cord which resemble those in poliomyelitis in the human being. This organism can be recovered and may be used to reproduce the disease. The organism has been rendered filterable, and an identical organism has been isolated constantly from the brain and cord of monkeys paralyzed with fresh glycerolated and filtered virus. The more sensitive strains, both from human and monkey poliomyelitis, are agglutinated by the serums of persons and monkeys that have recovered from the disease, and they claim that injections of the recently isolated aerobic cultures into monkeys render them refractory to the virus. They also give their results in the treatment of cases with the serum of a horse immunized with freshly isolated strains.

Rosenow, Towne and Hess¹⁰⁰ have reviewed the literature and published a bibliography of the streptococcus and its relation to poliomyelitis, and have given in detail their observations, which show that the streptococcus which they have described in the disease tends to localize electively in the central nervous system in young guinea-pigs, rabbits, puppies, kittens and less often in the adult animals of these species and in adult monkeys. As above noted, the symptoms and lesions produced resemble those found in human poliomyelitis. Cultivation on artificial media, particularly under aerobic conditions, usually destroys the elec-

⁹⁸ Journal of Infectious Diseases, February, 1918, p. 169.

⁹⁹ Ibid., xxii, p. 280.

¹⁰⁰ Ibid., p. 313.

tive localizing power, and this is also true of successive animal passage. They restate their view that the streptococcus is not a secondary invader, but has a definite etiological significance in the disease.

The Agglutination of the Pleomorphic Streptococcus. Rosenow and Gray¹⁰¹ have made some observations with the streptococcus which Rosenow isolated from the tonsils and central nervous system of human poliomyelitis, and from the central nervous system of monkeys paralyzed with poliomyelitic virus. Both strains of organisms are cross-agglutinated in high dilution by the serum of horses immunized with human and monkey strains and in lower dilution by the serum of persons who have had poliomyelitis. Streptococci and pneumococci from sources other than poliomyelitis were found with few exceptions not agglutinated more by the antipoliomyelitis serums than the normal horse serum of Rosenow. They believe that by the agglutination test it is possible to differentiate between the streptococcus and the *Streptococcus viridans*, the latter of which has been occasionally isolated from the central nervous system of uninoculated and inoculated animals.

Microscopic Demonstration of Cocci in the Central Nervous System. Hektoen, Mathers and Jackson¹⁰² made a study of the central nervous system with material obtained from various sources and different places. Owing to the variation in time after death that the tissues had been fixed, as well as on account of the different fixatives employed, they did not obtain uniform results with all the methods of staining that were used. The cocci were found to stain more satisfactorily with the Gram stain, but methylene blue and eosin and polychrome methylene blue and eosin were used with good results. The cord and other parts of the central nervous system in about 50 instances of epidemic poliomyelitis in various parts of the country were found to contain cocci, which looked quite like the organisms which may be grown in cultures from the brain and cord in the disease. The observers believe that these cocci occur constantly in the central nervous system in poliomyelitis and that their presence is inexplicable as due to accident or contamination.

Solis-Cohen and Heist¹⁰³ also state, from the result of their investigations, that there is frequently present in poliomyelitic material a rather large streptococcus, occurring in short chains, and that the serums of a large percentage of patients with the disease give high opsonic indexes with this streptococcus, but not with streptococci from non-poliomyelitic sources, nor with staphylococci or diphtheroids, nor with Gram-negative bacilli obtained from poliomyelitic material.

The same authors¹⁰⁴ have made a comparative study of cocci isolated from poliomyelitic material from different sources, in all, eight strains having been studied. These were grown side by side on the same media and had applied to them the same cultural and fermentative and other tests used in classifying streptococci. Six of the strains so examined seemed to be identical or closely related, but examined by methods to test their functional activities, three of the strains from human spinal

¹⁰¹ Journal of Infectious Diseases, 1918, xxii, p. 345.

¹⁰² Ibid., January, 1918, p. 89.

¹⁰³ Ibid., February, 1918, p. 175.

¹⁰⁴ Ibid., p. 182.

fluid were found to be identical. When grown under strict anaërobic conditions for some time these organisms tend to diminish in size and to become Gram-negative. The authors believe that these small forms are distinct from the globoid both in their biological and morphological differences.

Cultivation of the Virus. Wayson,¹⁰⁵ using Noguchi's technic and certain modifications of it, and also using Rosenow's technic, which is similar to that of Noguchi except as to the composition of the media, found that in a series of 208 primary cultures 13 per cent., or 28, showed diplococci and streptococci. Seven per cent. showed cocci and 23 per cent. diphtheroids. In many instances more than one of the above types were found in the same tube. None of the organisms cultivated reacted in the small laboratory animals nor in monkeys with clinical or histological evidence of the disease. The results obtained by Noguchi and by Rosenow could not be duplicated, although approximately 700 primary cultures and 300 animal tests were made.

Complement Fixation of the Specific Antigen. Neustaedter¹⁰⁶ has produced an antipoliomyelitic horse serum by injecting the animal with the virus of the disease previously digested with trypsin. As a result of this work, an antigen was produced potent enough to produce a complement fixation in sera and spinal fluids of typical and suspected poliomyelitis. They have succeeded in getting a specific antigen by filtering a 5 per cent. suspension of brain and cord of monkeys that have died of the disease through a Berkefeld or a Heim filter, sterile water being used as a menstruum. Trypsin is then added in proportion of 1 to 50 and permitted to act at room temperature for three hours, and then 0.4 per cent. trikresol is added to stop further action by the trypsin. This may be kept in a refrigerator and it maintains its activity for at least a month.

They have examined 152 spinal fluids and 60 blood serums, the patients ranging from two and a half to twenty-three years of age. The cases were frank and suspected, and some had fever and some not, and the disease varied in duration from one to forty days. Forty-two spinal fluids of frank and suspected cases showed in 23 a positive reaction, in 12 a doubtful reaction and 4 gave a negative reaction. Observations with other serums and fluids gave, with few exceptions, negative results. Neustaedter believes that the antigen will be found of value in making the diagnosis of the disease, and it certainly is worthy of a considerable amount of further study which will have to be put upon this subject before it can be adopted as a routine.

The Survival of Poliomyelitic Virus in the Brain of the Rabbit. Amoss¹⁰⁷ has found that suspensions of the central nervous tissues of monkeys containing the active filterable virus of poliomyelitis may be injected into the brain of rabbits without setting up symptoms, but care must be taken that the volume of the injection does not produce sufficiently increased intracranial pressure to be dangerous. Apart from the pos-

¹⁰⁵ Hygienic Laboratory Bulletin, 1918, No. 111.

¹⁰⁶ New York State Journal of Medicine, No. 8, vol. xviii, p. 328.

¹⁰⁷ Journal of Experimental Medicine, 1918, xxvii, p. 443.

sibility of producing pressure symptoms, no other effects or pathological lesions are produced by the suspensions. The active virus survives for four days. The virus of poliomyelitis is therefore unadapted for the rabbits, and differs in this respect from certain streptococci that have been found in poliomyelitic tissues. In the rabbit it neither produces lesions nor does it survive long in the central nervous organs. Amoss also immunized a monkey to the streptococcus cultivated from human poliomyelitic serum and which produced a serum which agglutinated the streptococcus in high dilution, but this serum was without any neutralizing effect on filtered virus, and this monkey, which was also immune to the streptococcus, was not protected against the effects of an intracerebral inoculation of the filtered virus. These observations may be taken as additional proof that the streptococcus which has been cultivated from poliomyelitic tissue is not the cause of epidemic poliomyelitis.

PHYSIOLOGICAL STIMULATION OF THE CHOROID PLEXUS AND EXPERIMENTAL POLIOMYELITIS. It has been shown that the active filterable virus of poliomyelitis may be injected into the blood of monkeys even in very considerable amounts without producing infection and paralysis, or only rarely. The reason given for this is the inability to pass the barrier of the choroid plexus and the vessels of the central nervous system. Flexner and Amoss have shown that sterile irritating chemical substances introduced into the subarachnoid space will so injure the choroid plexus and the bloodvessels of the meninges, and possibly of the central nervous organs also, that the passage of the virus from the blood into the nervous tissues is facilitated. When the virus of poliomyelitis passes from the blood into the nervous tissues, it leads to the development of symptoms of the disease, or, as Flexner and Amoss state, to infection, and paralysis and death may follow. They regard the meningeal choroid plexus in man as the defensive mechanism against infection in this disease. Flexner and Amoss have also shown that the qualitative changes in the meningeal choroidal-complex, which allow the virus to pass from the blood, may be exceedingly small and may be brought about by the mere substitution of the cerebrospinal fluid of one monkey for that of another. The changes produced by this procedure must be exceedingly slight, as Flexner and Amoss state, merely molecular, but they are sufficient to overcome the mechanism of defense. Dixon and Halliburton have shown that the secretory activity of the choroid plexus is influenced by a hormone present in the choroid plexus and, to a less extent, of the brain substance, and when this hormone enters the blood in increased quantities it causes a larger amount of cerebrospinal fluid to be secreted.

Flexner, Amoss and Eberson¹⁰⁸ have confirmed the observations of Dixon and Halliburton and have shown that when the intravenous inoculation of the virus does not in itself suffice to produce infection and paralysis, the intravenous injection of extracts of the choroid plexus, which in themselves excite the secretory functions which preside over the formation of cerebrospinal fluid, is powerless to modify this

¹⁰⁸ Journal of Experimental Medicine, 1918, xxvii, p. 679.

result, so that increasing the secretory functions of the choroid plexus from time to time through intravenous injections while the virus is still circulating in the blood will not cause the virus to pass into the nervous tissues. They also have shown that increasing the secretory functions does not exercise any restraining influence on the development of infection that might otherwise take place.

THE PASSAGE OF NEUTRALIZING SUBSTANCE FROM THE BLOOD INTO THE CEREBROSPINAL FLUID IN ACTIVELY IMMUNIZED MONKEYS. Flexner and Amoss¹⁰⁹ have determined that the neutralization of the virus of poliomyelitis by antibodies does not require an active complement. The neutralizing substances pass from the blood of actively immune monkeys into the cerebrospinal fluid if the permeability of the meningeal-choroidal complex is increased by an aseptic inflammation, such as that induced by an intraspinal injection of horse serum. It is possible that the passage of these neutralizing substances into the cerebrospinal fluid continues so long as the inflammation exists, as they can be detected in the affection as early as twelve hours and as late as forty-eight hours after the intraspinal injection of horse serum, and this passage of neutralizing substances into the cerebrospinal fluid doubtless is a matter of importance in arresting the increase of the virus, and hence the stopping of the poliomyelitic processes. The inflammatory condition of the meninges and the choroid plexus in the course of the disease permits the neutralizing substances in the blood to pass directly into the cerebrospinal fluid, and probably by transudation into the parts of the spinal cord and brain. As a result of their studies, Flexner and Amoss believe that the use of a specific alien immune serum to anticipate the individual's own immunity products appears to be logical, and that the employment of normal serum would seem to offer no therapeutic advantage.

THE PATHOLOGY OF POLIOMYELITIS. Abramson¹¹⁰ has made a careful study of 43 cases that occurred in New York during the epidemic of 1916, and, in addition to describing his own findings, discusses those of previous observers. Anyone especially interested in this subject will do well to read the article in its entirety, but for those who are not, the following statement regarding the pathogenesis of poliomyelitis will suffice:

"The virus has a special affinity for nerve cells, more particularly the anterior horn cells. It reaches the central nervous system by way of the perineural lymph channels. The process spreads in the central nervous system by the lymphatics. The congestion, edema and cellular infiltration, whether present in the pia or in the cord itself, are the cardinal elements of an inflammatory reaction in response to injury produced by the activity of the virus in the cord. The neurophagocytosis is not an active primary destructive process, but rather the exercise of the known normal functions of leukocytes, that of carrying off destroyed material. The congestion and edema, undoubtedly, play a considerable part in the production of transient paralysis through pressure effects."

¹⁰⁹ Journal of Experimental Medicine, July, 1918, p. 11.

¹¹⁰ Archives of Internal Medicine, September, 1918, xxii, p. 312.

The Hydrocephalus of Poliomyelitis. Regan¹¹¹ has made a study of this subject and outlined the histories in 6 cases. He calls attention to the fact that recent researches in the pathology of poliomyelitis show that edema is one of the prominent features, and that this condition is due to the interference with return flow of lymph, and also it is probably due to perivascular infiltration of the sheath of the bloodvessel walls, and there is also a tendency for the venous return flow to be obstructed. There may also be some changes in the vessel walls due to toxins. In the early stages of the disease the congestion also helps to increase the edema. The increase of the spinal fluid in the subarachnoid space and also in the ventricles of the brain may be ascertained by the quantities that may be obtained by lumbar puncture. The choroid plexus probably over-secretes the fluid, due to the unusual excitation. The symptoms produced are divided by Regan into those coming on in the preparalytic and early paralytic stages or at the onset of the disease, and those that appear after the first week. These he subdivides into three varieties: (1) a mild form commonly encountered in which there is only a slight increase in fluid and in which symptoms are practically absent; (2) a more severe form comprising various degrees, in which there are distinct signs of pressure; and (3) a very severe type, more insidious in its onset, indefinite in physical signs and associated with evidences of progressive emaciation.

The hydrocephalus of the onset shows drowsiness or stupor, dilated pupils which react rather sluggishly to light; irritability is marked, the respiration and pulse become rapid and sometimes irregular, and there are vasomotor flushings of various parts of the body. There may also be ataxia, headache, rigidity of the neck, and profuse sweating. Macewen's sign is marked and all the symptoms are promptly relieved by lumbar puncture.

Regan also suggests that examination of the eye grounds might be of value, particularly in cases that have persisted for several days. When the hydrocephalus persists after the first week of the disease, there is usually a slight Macewen's sign and an increase in the quantity of fluid on lumbar puncture, but with practically no symptoms, and this is usually the type met with. In other cases pressure symptoms are marked, there are dilated pupils, headache, drowsiness or stupor, rigidity of the neck and irritability when disturbed. There may be a persistently high temperature, together with a moderately increased respiration and pulse. The increase in pressure may be indicated by a positive Macewen's sign or by a bulging fontanel if the child is sufficiently young. Lumbar puncture, repeated once or twice, generally relieves the symptoms very materially.

In the persistent cases, which are rare, and generally seen in children that have been desperately ill the first week or two, extensive paralysis occurred. These children show a rapid loss of weight, despite the fact that large quantities of food have been given, and this goes on until there are extreme emaciation and trophic changes of the skin, especially

¹¹¹ American Journal of Diseases of Children, April, 1918, p. 259.

over the bony prominences. The mentality of the child gradually becomes dull, it ceases to take interest in the surroundings and finally dies in a state of acute inanition. In these cases lumbar puncture does not seem to be of any value.

Regan¹¹² has another article which deals with a review of our knowledge of Macewen's sign. He reviews the work of Macewen, Wilcox, and others, and gives the technic of eliciting the sign. His description of this is as follows:

"The pillow is removed from under the child so that the head lies on an even surface; the head is turned first to one side and percussion is carried on over the region of the parietal eminence which is lowermost, after which the position of the head is reversed and a similar area on the opposite side is percussed. It is often preferable to remove the child from the crib and lay it on a wooden table with a thin pillowslip folded beneath the occiput. It is essential that the room in which the examination is made be quiet, and that the examiner, by bending, bring his ear close to the child's head while the percussion is being carried out. Gentle tapping with the tip of the middle finger is just as effective in bringing out the note as hard, loud blows with the finger or a percussion hammer. The use of the latter instrument is open to the decided objection that it prevents the determination of the tactile quality of the sign.

The pterion was the point originally specified by Macewen for best eliciting the sign. We have also used this area in a great many cases, but, by comparison, have found that the regions of the parietal eminences are just as suitable, if not more so, especially since the parietal bone in that location is not covered by muscular tissue. In order to facilitate the determination of the degree of the positive sign, it is often useful to percuss the skull from behind forward, starting at the lambdoid suture and ending just behind the frontal eminence, following a line which would be just superior to the upper temporal ridge and which passes through the parietal boss. If a marked Macewen's sign is present, the typical sound will usually be elicited over most of the entire area percussed; with a moderate or slightly positive sign, the sound will be proportionately more localized to the parietal eminences or to the pterion."

The Spinal Fluid in Poliomyelitis. Among the studies made during the epidemic in New York, in 1916, was one by Larkin and Cornwall.¹¹³ They found that there was an increase in the pressure in 93.5 per cent. of those examined from the first to the fifteenth day of the illness, and that this increase in pressure persisted longer than any of the other fluid changes. They also noted that 93 per cent. of the fluids showed an increase in the globulin content. This came on before the cell changes and persisted after. An increase in the number of cells was found in 86 per cent. of the cases. The small lymphocytes predominated, and it was also found that there was a diminution in the amount of globulin. With the colloidal gold reaction of Lange, the reaction was variable, and they did not believe that this test furnishes information of any

¹¹² American Journal of Diseases of Children, July, 1918, p. 13.

¹¹³ Archives of Pediatrics, August 1, 1918, p. 459.

particular value. Larkin and Cornwall did not find any parallelism between the Lange reaction and the spinal fluid or blood findings. The height of the curves increased with the severity of the infection, and the higher curves were generally noted from the tenth to the fifteenth day. The fluid from five fatal cases was in three instances of the luetic type and in two of the paretic type.

THE TREATMENT OF FIFTY-EIGHT CASES OF POLIOMYELITIS WITH ROSENOW'S SERUM. Rosenow¹¹⁴ has reported in detail the results obtained by the use of his serum in 58 cases of the disease which occurred in Davenport, Iowa, and its environs during the summer and autumn of 1917. The injections were given intravenously, and altogether 94 injections were made and in only 6, or 10 per cent., was there any later evidence of serum disease. Of the 58 patients treated, irrespective of the severity of the type of the disease, 10 died, or a mortality of 17 per cent. Excluding 7 of the fatal cases in which the patients were practically moribund at the time of treatment, there were 3 deaths, or a mortality of 6 per cent. In contrast to this, it is noted that there were 23 untreated cases in which 9 patients died, a mortality of 35 per cent.; including the moribund patients that were untreated, there were 16 deaths out of 30, or a mortality of 53 per cent. The method of juggling figures suggested a well-known saying about statistics. In no single instance, when the treatment was begun at its onset, did paralysis develop, and all of those cases treated early recovered.

The comparison with work of other observers is not uninteresting and is given by Rosenow. According to Draper, about 50 per cent. of cases developed paralysis if untreated. Zingher, using immune serum, treated 54 cases, 18 per cent. of which developed paralysis and there were no deaths. Amoss and Chesney treated 14 patients, 29 per cent. of which developed paralysis, and 14 per cent. died. Peabody treated 51 patients, 31 per cent. of which developed paralysis, and 10 per cent. died. Nuzum and Willy, using their serum, treated 14 cases, one of which, or 7 per cent., died, and none of the cases that recovered developed paralysis.

Rosenow also did not encounter any extension of paralysis in cases in which the serum was used, and in only 8 per cent. of these patients is there permanent impairment of function present, and in all but one case this impairment is slight. Rosenow is firmly of the belief that the pleomorphic streptococcus is not a secondary invader, but is in some way, as yet partially obscure, the cause of epidemic poliomyelitis. He believes that he has demonstrated the harmlessness of his serum, and believes it to be of definite value so long as postparalytic pains are present and so long as there is a positive spinal fluid. In combination with all others who have had any opportunity of studying this disease at first hand, he believes that the course of it should be considered in terms of hours and not days, especially as regards the serum treatment.

THERAPEUTIC VALUE OF ROSENOW'S ANTIPOLIOMYELITIC SERUM. Amoss and Eberson¹¹⁵ have made some observations on Rosenow's

¹¹⁴ *Journal of Infectious Diseases*, 1918, xxii, p. 379.

¹¹⁵ *Journal of Experimental Medicine*, 1918, xxvii, p. 309.

antipoliomyelitic serum, which, it will be remembered, is produced by injecting a horse with the streptococci which he has cultivated from poliomyelitic cases. Those who have made a study of the organisms of poliomyelitis may be placed in two groups, (1) those who believe that the streptococci bear a causal relation to poliomyelitis and are even related biologically to the globoid bodies of Flexner and Noguchi, and (2) those who deny that they possess any essential etiological importance and regard them merely as secondary invaders.

Amoss and Eberson made two series of observations, comparing the serum with the immune serum derived from monkeys which had convalesced or recovered from the disease produced experimentally. The observations were made by injecting the active virus of poliomyelitis into the blood and injecting the two kinds of serum into the cerebrospinal meninges according to the method of Flexner and Amoss. The control monkeys, those receiving the virus intravenously alone did not develop paralysis, while those receiving the virus intravenously and normal horse serum intraspinally developed paralysis. The monkeys receiving the virus intravenously and Rosenow's antipoliomyelitic serum intraspinally developed paralysis in the manner of those receiving normal horse serum intraspinally. The monkeys that received the virus intravenously and the convalescent or immune monkey serum intraspinally alone did not develop paralysis. This seems to prove that the Rosenow serum acts in the manner of normal horse serum in that it promotes the passage of the virus of poliomyelitis from the blood into the nervous system and it does not protect from infection.

NUZUM'S ANTIPOLIOMYELITIC SERUM. Nuzum and Willy¹¹⁶ have been able to produce a highly potent immune serum in the horse by repeated intravenous injections of aërobic cultures of the poliomyelitic coccus, and they found that monkeys can be immunized against several fatal doses of virulent monkey-adapted virus by using this serum in repeated intravenous and intracerebral injections. They also found that this serum possesses protective and curative properties against the virus in experimental poliomyelitis of monkeys.

Amoss and Eberson¹¹⁷ have made some observations on Nuzum's serum by immunizing a horse with streptococci obtained from cases of poliomyelitis. This serum is apparently similar to that made by Rosenow, but is prepared in a somewhat different manner. Nuzum was able to cultivate streptococci from cerebrospinal fluid removed by lumbar puncture from 90 per cent. of cases of the disease studied, and in this observation he stands alone, inasmuch as other observers have not been able to confirm it. Nuzum believes that his serum is therapeutically active because of the neutralization of the virus *in vitro*, the neutralization of the virus *in vivo* by intraspinal injections of the serum, and the neutralization of the virus *in vivo* by combined intraspinal intravenous and intramuscular injections of the serum.

The tests were made with serum supplied by Nuzum. Without going into the details of their observations, their conclusions may be

¹¹⁶ Journal of Infectious Diseases, March, 1918, p. 258.

¹¹⁷ Journal of Experimental Medicine, September, 1918, p. 323.

stated as follows: That the neutralizing or therapeutic power when applied by their methods against small doses of the poliomyelitis virus has failed to show any results in monkeys. Under the same conditions the serum of monkeys recovered from experimental poliomyelitis proved neutralizing and protective. The experimental and other evidence adduced, by those who regard the streptococcus as playing an essential part in the pathology of experimental poliomyelitis and the antistreptococcic serum as exhibiting therapeutic properties for man and monkeys, is regarded as imperfect and inconclusive.

Epidemic Stupor in Children. Batten and Still¹¹⁸ describe a series of cases that had come under their observation in March and April, 1918. Three were children admitted to the Great Ormond Street Hospital, aged eleven, seven and four years respectively, and one into King's College Hospital, aged three and a half months. The children were in a stupor that at first sight suggested tuberculous meningitis. The stupor developed rapidly without convulsions, but in one case it was preceded by listlessness, a dreamy state and inability to do his work at school.

On admission to the hospital, the children lay in an unconscious condition on their backs with their eyes closed, their legs extended and the arms sometimes flexed or extended. There was a general rigidity of the muscles and a general catalepsy, inasmuch as the muscles could be moved in any direction, but had a tendency to remain where placed. There was a rhythmic tremor of the hands and forearms, and the face had a peculiar mask-like appearance. Even though apparently unconscious, the patients could be roused, would follow a light, put out their tongue at command. It was noted, when the eyelids were raised passively, that the eyes were irregular, and there was nystagmus, the eyes moving in all directions in an incoördinate manner. In one case the eyes were also turned up. The children swallowed well, as a rule. They cried in a curious manner, sometimes for hours, but did not speak. There was no retraction of the head or neck, apart from the same rigid condition seen in the extremities. If stood up they would balance and walk slowly forward if encouraged to do so, but no notice was taken of their surroundings. There was incontinence of the urine and feces. No signs of organic disease could be found on examination. The temperature was raised for a few days at the onset, while the pulse was slow and the respirations were normal. There was a tendency to perspire profusely about the head and upper extremities. The deep and superficial reflexes were normal. The cerebrospinal fluid and eye grounds were normal and showed no cell or chemical changes. The Wassermann reaction was negative. The blood, feces and urine were apparently normal.

The disease tended to recover and after lying from three to five weeks the children took notice, began to speak in a slow, hesitating manner, often indistinctly. The authors believe that the disease is probably infectious in character, that it is not due to the ingestion of sausage, ham or tinned foods, or any other source of so-called botulism, inasmuch

¹¹⁸ Lancet, May 4, 1918, p. 636.

as it has occurred in an exclusively breast-fed infant, and a supposition that it may be due to nervous shock from air raids seems to be not tenable for the same reason.

Netter¹¹⁹ has described a somewhat similar epidemic occurring in the children of Paris, the prominent symptoms of which were headache and lethargy. He believes it some form of encephalitis. Crookshank¹²⁰ is inclined to believe that this condition is some form of poliomyelitis.

In another communication, Netter¹²¹ has considered this subject at greater length and he gives it the name of *l'encéphalite léthargique épidémique*. This disease presented itself not only in Paris but in various parts of France, for example, at Rouen and Havre. The first French cases were noted at the beginning of February. The first English cases on February 27. The most marked symptom is the somnolence, and there may be at the beginning pains in the head and vomiting. The patient is taken with lassitude and cannot keep awake, but will respond to questions asked in a very definite manner. As soon as he carries out the order he turns to sleep. In the more marked cases the patient lies in bed incapable of making the slightest movement. In some the condition may be that of coma. There may be bilateral or unilateral ptosis, and partial or total paralysis of the extrinsic eye muscles, and, less frequently, of the internal muscles of the eye. Nystagmus is common. The paralysis may be extended to the muscles innervated by the facial nerve, the soft palate, the tongue, the larynx and pharynx. The arms and legs are less often affected and rarely under the form of real paralysis. There is more often awkward coördination and tremor and exceptionally clonus or contractures. There is no disturbance of sensation, or, if any is present, it is slight. In some there is aphasia, paralysis of the sphincters and of the bladder. Most of the patients have fever of short duration. The cases are often mistaken for meningitis, but rigidity, Kernig's sign, irregularity and slowness of the pulse are either present in a very trifling degree or wanting altogether, but the tâche cérébrale is practically always present.

The fluid removed at lumbar puncture was clear, without abnormal tension, the albumin and glucose reactions normal, and either no change in the number of cells or very slightly increased. Netter found from one to seven lymphocytes in his cases, and he believes the normal character of the cerebrospinal fluid is of great importance in the diagnosis. The course of the disease is variable. In certain cases the duration is but a few days, the patient either ending in complete recovery, or by death with symptoms of bulbar involvement. More often the disease is prolonged to weeks or even two or three months or more, and cases that have run this length of time may get well. In these prolonged cases bedsores are common.

The mortality was about 50 per cent. At autopsy, there was some congestion of the meninges, small hemorrhages in the nervous tissues and sometimes larger ones. Microscopically, the lesions showed cellular

¹¹⁹ Lancet, April 27, 1918, p. 611.

¹²⁰ Ibid., May 18, 1918, p. 699.

¹²¹ Bulletin de l'Académie de Médecine, May 7, 1918, lxxix, p. 337.

infiltration, most marked about the vessels. The changes are most marked about the medulla, pons and base of the brain. In the cases in which the symptomatology resembled that of poliоencephalitis superior of Wernicke, the changes occupied the seat of the lesions described by that author. As early as 1875, Gayet described similar lesions in an article in the *Archives de Psychologie*, and his patient also had somnolence and paralysis of the eye muscles. As early as 1712, there was an epidemic of a somewhat similar disease at Tübingen, which was given the name of *Schlafkrankheit*. In the winter of 1916-17, there was an epidemic of a similar affection in Vienna, which, according to Netter, was described by von Economo.¹²² There were 11 cases described, of which 6 died.

Netter does not believe that this disease is a form of poliomyelitis. He states that the etiology, the pathological anatomy, the symptoms and the course are essentially different, but that it is a disease met with in cold seasons, winter and spring, while the epidemics of poliomyelitis are in summer and autumn. He also states that the disease is much more common in grown people than in children, and also that it is very much more fatal than poliomyelitis.

Harris¹²³ described 7 cases of the disease which he believed due to alimentary intoxication, but Netter points out that in none of the French cases were there any symptoms of botulism, that is, extreme dilation of the pupils, dryness of the mouth and throat, excessive thirst, obstinate constipation and the like, and up to the present time there has never been more than 1 case of encephalitis described in any one house, whereas in botulism many individuals were taken sick simultaneously. Netter believes that the disease is due to some specific agent which is yet to be determined and thinks that the disease appeared after the influenza epidemic of 1890, and that following that epidemic there were a number of cases described, and he believes that it has existed in a sporadic state, and under the influence of unknown causes takes on the character of an epidemic, and also that there are certain slightly developed forms which may be responsible for spreading the contagion. Certainly, until it is proved otherwise, those cases resembling the encephalitic type of poliomyelitis, which, as is well known, appears sporadically and in the course of epidemics of that disease. There have, as is also well known, been quite a number of epidemics of it in wintertime.

Rat-bite Fever. Dick and Tunnicliff¹²⁴ have described a streptothrix which was isolated from the blood of a patient bitten by a weasel. The patient was a boy, aged ten years, whose clinical history was typical of rat-bite fever. They suggest the name of streptothrix putorii, and while the clinical picture was similar to that of rat-bite fever, the streptothrix differs, both morphologically and culturally, from that of the Streptothrix muris-ratti, which has been described by Schottmüller, Blake, and Litterer and Tileston, and differs also from the streptothrix isolated from the blood of a boy bitten by a South African squirrel and

¹²² Wien. klin. Wchnschr., May 10, 1917, November 27, 1917.

¹²³ Lancet, April 20, 1918.

¹²⁴ Journal of Infectious Diseases, August, 1918, xxiii, p. 183.

described by Schottmüller. It also differs from the similar streptothrix isolated from the bronchopneumonia of rats by Tunncliffe. In this connection it will be remembered that spirochete have been described in the blood, skin and lymph nodes, kidneys and adrenals of patients with rat-bite fever by Futaki, Kaneko, Ido and Kitagawa.

THE TREATMENT OF RAT-BITE FEVER. In the past few years I have reviewed the various reports on this disease—the Sodōku of the Japanese. Futaki's finding of the spirochete in the lymph nodes has been confirmed by Kaneko and Okuda. In 1912, Hata refers to 8 cases of rat-bite fever treated by salvarsan. In all, the symptoms disappeared quickly, but in 2 cases there was a relapse, the dose having been in these rather small.

Low and Cockin¹²⁵ have reported a case in a man, aged twenty-five, successfully treated by novarsenobillon. He was bitten January 31, 1917, on the back of the right forearm. This healed up and was practically gone when, some seven days later, pain commenced at the site which swelled up and subsequently fever and general adenitis developed. He was not treated until December 17, when he was given 0.4 gram in the afternoon. The second injection on January 3 was 0.6 gram. At this time the patient had been free from fever, was feeling much better, but he was given a third injection on January 25 of 0.9 gram. There had been no return of the disease since and the patient was apparently completely cured.

Relapsing Fever Endemic in Colorado. In 1915, Meader¹²⁶ reported 5 cases of this disease, in 2 of which he found the spirochete. Osler notes that the disease occurred in New York and Philadelphia in epidemic form in 1869, but that it has not reappeared. There was a severe epidemic in California in 1874 among Chinese laborers. Waring¹²⁷ has an interesting article on the subject, but he was not able to find any instance on record of the disease in which the spirochete was found in the blood originating in the United States among native Americans, up to the cases reported by Meader. Waring also reports a case in a boy, aged twelve years, and a spirochete, probably the *Spironema novyi*, was found in the blood during the first attack.

Scarlet Fever. **ETIOLOGY OF SCARLET FEVER.** Pryer and Kelly¹²⁸ and Pryer and Sewell¹²⁹ have described an organism isolated from the blood of a man dying from scarlet fever. A similar organism was isolated from the throats of scarlet fever patients, although in only a very low percentage of cases studied. A similar organism has been described by Cantacuzene, and he showed that it will produce in monkeys a condition closely resembling scarlet fever. The organisms vary in length from 2 to 8 microns and seldom exceed 4 microns in diameter. In young cultures the organism tends to be spherical in shape, stains readily and its behavior to the Gram stain is not constant, although it is generally Gram-negative. With Giemsa's, a red granule can be made out

¹²⁵ British Medical Journal, February 16, 1918, p. 203.

¹²⁶ Colorado Medicine, 1915, p. 365.

¹²⁷ American Journal of the Medical Sciences, June, 1918, p. 819.

¹²⁸ Journal of Laboratory and Clinical Medicine, February, 1918, iii, p. 269.

¹²⁹ Ibid., June, 1918, iii, p. 531.

in a faintly-staining central portion. Preparations made from the cultures of these organisms by a method similar to typhoidin give a higher percentage of reactions in scarlet fever convalescents than in other infectious diseases.

The authors suggest the name of *Scarlatin* for the preparation. They determined that the probability of getting a positive reaction with it increases with the duration of the disease, and, in people with no history of scarlet fever, increases with the age of the individual tested. While they do not claim to have proved that this organism is the etiological factor in scarlet fever, they believe that they have presented sufficient evidence to have it given serious consideration. In testing 125 patients with scarlet fever, they had positive reactions in 56.7 per cent.; in testing persons without scarlet fever the positive results were 16.5 per cent. It seems highly probable that this organism may be one which has been described before as being associated with scarlet fever.

THE TREATMENT OF SCARLET FEVER WITH IMMUNE HUMAN SERUM. This is a subject which has received a certain amount of attention, and Weaver¹³⁰ has briefly reviewed the work of others and given his experiences at the Memorial Institute for Infectious Diseases at Chicago. The fact that individuals who have had one attack of scarlet fever were generally immune to subsequent attacks led Weisbecker, in 1897, to treat 5 cases with the blood-serum of convalescents. His results may be considered negative. From that time to 1903 the same method was used by Huber and Blumenthal, von Leyden, Rumpel and Scholz. They used relatively small doses given subcutaneously without any definite results. For the next ten years the fear of transmitting syphilis and other infections led to the abandoning of this method, but, with the introduction of the Wassermann reaction, Reiss and Jungmann, in 1912, treated 12 very severe cases by intravenous injections of 40 to 100 c.c. of convalescent serum. In 10 of their cases they claimed to have produced marked benefit. The blood was generally taken from the end of the third or beginning of the fourth week of the disease and the serum tested for sterility and syphilis, and the serums of several patients mixed together. The following year Koch reported 22 cases, with one death. He reported that the fever fell promptly, followed by a slight rise and then a marked improvement in the general condition. He believed his good results were due to the early administration of the serum. Satisfactory results were reported in 1915 by the same author, and by Reiss and Hertz. In the same year, Zingher treated 15 cases selected from 900, but with 4 deaths. Two died from septic conditions, and the other two were moribund when received. Zingher's method was to draw the blood from the donor at the median cephalic vein at the bend of the elbow and immediately citrate it by adding 1 c.c. of 10 per cent. solution of sodium citrate to each 30 c.c. of blood; injecting 15 to 30 c.c. at a time into several of the larger muscle groups, from 75 to 240 c.c. in all being given at one dose.

Weaver treated 19 cases, the blood being taken from the twentieth

¹³⁰ Journal of Infectious Diseases, 1918, xxii, p. 211.

to the twenty-eighth day of the disease, the doses being from 25 to 90 c.c., with an average of 60 c.c. In most cases only a single dose was given, but in a few a second was used when the first one did not show good results. The injections were made into the muscles on the outer side of the thigh, usually dividing the dose between the two sides. A fall in temperature was noted in from two to four hours, and continued until its limit was reached in from twelve to twenty-four hours. In cases that were purely toxic, after the temperature reached normal there was little tendency to rise again, but, when septic complications were present, there was an initial fall followed by general improvement, but the fever rose again and ran a course such as occurs in septic cases, but, so far as one could judge, not quite as high as usual. The earlier the serum was given, the better were the results. Most of Weaver's patients were received at the hospital on the fourth and fifth day. Out of the 19 cases there was only one fatal result which was in a girl, aged two and a half years, who entered the hospital on the fourth day with an ulcerative angina and a severe adenitis and very marked cyanosis.

SCARLET FEVER CARRIERS. Lewis¹³¹ has a third article on the subject of demonstrable carriers of scarlet fever by means of finding a streptococcus. He believes by this means it is possible to pick out carriers in reported cases in families or neighborhoods or in individuals who are having recurrent sore-throats. He believes that the isolation and treatment of carriers of scarlet fever bear the same relation to scarlet fever as the diphtheria carrier does to the control of diphtheria.

Smallpox. **SMALLPOX AT EAGLE PASS.** Eskey¹³² has given an account of this disease as it occurred from October, 1917, to March, 1918, in a Mexico border town of an estimated population of 6500, of which approximately 4200 were Mexicans. There were 150 cases of unusual virulence, inasmuch as the mortality was 22 per cent., which is in marked contrast to the mild attacks of the disease that have more recently been met with in the United States. Eight cases of the disease are recorded as occurring in persons previously vaccinated. In one case the disease was in a fairly severe form of discrete smallpox, and the others had very mild varioloid. Four other patients with the disease claimed to have had smallpox on a previous occasion, and, although proof of this was not forthcoming, one woman at least was able to show scars of what looked like old smallpox lesions. Of course, it is well known, as Eskey suggests, that it is sometimes possible to successfully vaccinate an individual who has had smallpox, and if such an individual were not vaccinated he might not be susceptible to the disease. There were at the time of the epidemic a considerable number of cases of chicken-pox which gave some difficulty in diagnosis, and, of course, it is possible that in some cases in which the patient was supposed to have had smallpox previously, it might have been a severe chicken-pox.

The spread of the disease was greatly facilitated by the unhygienic conditions under which the people lived, and the promiscuous visiting, particularly to the sick, and there was a marked tendency to conceal

¹³¹ Boston Medical and Surgical Journal, September 19, 1918, p. 389.

¹³² Public Health Reports, September 20, 1918, p. 1580.

cases or to delay the report, and in some instances the diseased individual was moved from town to town. The disease is not looked on with any degree of seriousness by the Mexicans, who consider it exceedingly common, and the high mortality does not seem to make any great impression. This virulent epidemic is, of course, an added argument to the necessity of insisting on general and repeated vaccination for the prevention of the disease.

INTRADERMAL VACCINATION AGAINST SMALLPOX. This method dates from the early days of smallpox inoculation, Daniel Sutton having originated the method and published an account of it in 1796 in London. It was introduced in England in 1763. In America it was made the subject of a contribution by Thomas Dimsdale in Philadelphia in 1771. Curiously enough, there have been singularly few contributions dealing with the subject of intradermal vaccination which has been studied recently by Wright¹³³ at Camp Upton, New York. The method used was as follows: Virus treated with a glycerol-phenol solution was employed, the composition being phenol, 1 part; glycerine, 49 parts; and water, 50 parts. The virus was diluted with equal parts of sterile distilled water immediately before using, although in a few cases undiluted virus was used. The dilution was made to avoid waste, and it was soon discovered that the diluted virus gave just as good results as the undiluted. One-tenth c.c. of the diluted virus was injected intradermally by the use of a tuberculin syringe and a relatively fine needle, which was also sterile. The site of injection was the skin area covering the insertion of the deltoid muscle. In some cases only one injection was made, but in most, two injections were given an inch apart. Control vaccinations by the incision method were made on all the men on the same arm on the same day and with the same virus.

Two hundred and twenty-seven men were vaccinated by the intradermal method, all of whom had been unsuccessfully vaccinated by the incision method a number of times. In 160, or 70.48 per cent., the intradermal method was successful, whereas the incision method gave good results in only 19, or 8.3 per cent., and in all of these latter there was also a successful result by the intradermal method. In those 67 cases which failed to "take" by the intradermal, all but 4 showed an immunity reaction or a vaccinoid, most usually the former.

The course of the eruption in the primary vaccination by the intradermal method was in every way like that which occurs after the other methods, except that the vesicles form a circle around the site where the virus is deposited. The vesicles appear, as a rule, on the sixth day, change to pustules on the seventh or eighth, and reach their maximum diameter on the eighth or ninth day, at which time they usually measure from 0.5 to 1.4 c.c. Drying begins usually on the ninth or tenth day, and there is usually a good scab on the twelfth or fourteenth day which separates usually from the eighteenth to twenty-fourth day, leaving a sharply circumscribed, reddish, circular, depressed scar, which may or may not show foveation.

¹³³ Journal of the American Medical Association, August 24, 1918, p. 654.

Wright believes that this is the best method to use, and gives a greater percentage of "takes" and there is less chance of infection. It also has the advantage that one knows the amount of virus used. The only disadvantage is the fact that it requires more virus, 1 c.c. being necessary for from 16 to 20 persons, while by means of the other methods this amount will do for 40 to 50 vaccinations. It is somewhat more rapidly done than any of the other ways.

PURE VACCINE VIRUS CULTIVATED *in Vivo*. Noguchi¹³⁴ has shown that vaccinia virus free from bacterial impurity and at the same time of sufficient strength for practical purposes can be propagated in the testes of certain animals, particularly rabbits. More recently he has made further studies on this subject, and has found that the virulence of the vaccine virus for the testicular tissues increases until its maximum is finally reached. This selective increase is not associated with any loss, reduction or modification of its virulence for the skin, and he found that when the vaccine was highly potent for testicular tissue it was also highly active for the skin. Vaccine virus so produced has no more tendency to localize in various organs than that obtained in the ordinary manner. It was found that both may localize in adjacent lymph nodes when introduced intravenously, subcutaneously, or intratesticularly in sufficiently large quantities, but it shows no tendency to involve other organs. If, however, a very large amount of potent vaccine virus (1 to 2 c.c. of undiluted stock emulsion) is injected intravenously, it will produce a generalized eruption over the entire body surface of rabbits, and this occurs without reference to the source of the virus. This eruption may become confluent on the mucous membranes. The same virus injected subcutaneously or by the intratesticular method does not produce these effects. Smaller quantities of the virus, given either subcutaneously or intravenously, do not cause either an appreciable local or general reaction in the rabbits, but animals so treated seem to develop an active immunity which prevents their subsequent vaccination as applied to the skin. The testicular strain of vaccine virus is apparently best preserved with Ringer's solution or 0.9 per cent. salt solution. Distilled water is an exceedingly good diluent, but in this medium the virus does not remain active as long as in the solutions just mentioned. If the virus is kept cold, it retains its activity, but it deteriorates rapidly at from 18° to 37° C. Even after standing several weeks at 37° C., a small part of the virus survives.

His observations on the chemical agents that are usually employed in the so-called ripening process that is used to eliminate bacteria show that in the choice between glycerol and phenol the latter is the least destructive to the virus. Phenol in a solution of 2 per cent. will inactivate the virus in twenty-four hours at any temperature, but used in 0.5 per cent. does not produce any untoward result. Glycerol is very active in killing the virus, and even at 4° C. when used in full strength, will destroy the virus in twenty-four hours. A 40 per cent. solution is ordinarily used for ripening and the virus in this will retain some of

¹³⁴ Journal of Experimental Medicine, 1918, xxvii, p. 425.

its virulence to some degree for half a year if kept at 4° C., but in higher degrees the virus is killed in one or two months. This action on the vaccine virus is markedly increased at a temperature of 18° to 37° C. The virulence is best preserved in a sealed tube together with either hydrogen, nitrogen or air. In an open receptacle the virus deteriorates, and it also deteriorates when placed in a sealed tube with oxygen or carbon dioxide. The virulence is also decreased by drying, but the virus may retain its viability about as long as it does when emulsified. The most powerful disinfectant for vaccine virus is iodine.

Sporotrichosis Following a Mouse Bite. In spite of considerable work done upon this subject, there is much to be learned about the life-history and the mode of transmission of the sporotricha. The disease practically always follows an injury to the skin. It also seems to occur spontaneously in the horse, mule, dog, rat and man. In Brazil, the disease has been observed in rats, and it is thought by Lutz and Splendore that the disease was commonly transmitted from animal to man through bites and scratches.

The literature on the relation of the animal and human sporotrichosis has been reviewed by Meyer.¹³⁵ There have been some exceedingly interesting reports, including that of Sutton, in which the disease followed a hen bite on the back of the hand; one by Olsen, occurring on the back of the hand in a patient who had killed many gophers, some of which were affected with sores; and the case of Jeanselme and Chevallier, in a woman in which a nodular gummatous lesion appeared on the arm after the bite on the thumb by a white rat, the animal suffering with the disease produced for purposes of observation. There are also instances in which the disease followed bites of the horse and the dog. There is no particular evidence to show that the organism is present in the mouth of the animals, and the bite may simply serve, as any other wound might, as a portal of entry.

Moore and Davis¹³⁶ observed a case in a boy, aged thirteen, who was bitten on the index finger by a field-mouse. This incident occurred in North Dakota. About two weeks later there was swelling of the finger and about a month later there was an abscess which was opened, with discharge of yellow pus. A little later, a painless nodule was discovered on the arm, some distance above the wrist, and some three weeks later cultures were made from the lesion by the authors. The organisms were demonstrated, and the patient placed upon potassium iodide. At the time of the report, the lesions were apparently slowly healing under the influence of this drug, which is believed to be a specific for the disease. It is interesting that these reviewers made complement-fixation tests at various times which yielded definitely positive results, which corresponded to the agglutination tests. Tests were also made by the use of intradermal injections of 0.1 c.c. of sporotrichin preparations of de Beurmann and Schenck-Hektoen strains diluted with a like amount of normal salt solution. All of these strains yielded strongly positive reactions. Similar tests made with the blastomyces antigen

¹³⁵ Journal of the American Medical Association, 1915, lxy, p. 576.

¹³⁶ Journal of Infectious Diseases, September, 1918, p. 252.

did not cause any reaction in this patient, nor did a blastomycotic patient react to any of the sporotrichum antigen.

Monilia Vaccine in the Treatment of Sprue. Michel¹³⁷ has done some work on the serologic reactions of the disease, using the organism isolated by Ashford, the *Monilia psilosis*. Using the *Monilia psilosis* antigens, he has found complement fixation in cases of sprue. The diagnosis of the disease is based on sore tongue, excessive intestinal fermentation, light, foamy diarrhea, diminution in the size of the liver, and emaciation.

Michel is of the opinion that the toxic substance of the organism is an endotoxin and, using an emulsion of the sterilized monilia, was able to produce a relative immunity to injections of living cultures in guinea-pigs. His results along this line led him to make a vaccine for use in human beings. First injections were followed by pretty severe reactions, so that very small doses should be used at the beginning; and the second injection not given for less than eight to ten days after the first. The interval between the injections will probably be found to vary with the condition of the patient. There is usually a marked improvement in the patient's condition after the second injection; the third injection is given ten days after the second, the fourth, twelve days after the third, and the fifth, fourteen days after this, and the sixth injection two weeks later. Of 81 cases, 62 completed the treatment. In all of these the diagnosis was made by Ashford, and in all cases the *Monilia psilosis* was isolated from the feces, and in all cases the complement-fixation test was positive. Of the 62 patients, 49 were discharged cured, 12 were improved and 1 died. The treatment seemed to give more favorable results in Americans than it did in the Porto Rican natives.

Torula Infection in Man. Pierson¹³⁸ has added a case of this infection of which there are only 6 cases on record. Anyone interested in this infection will do well to refer to the monograph of Stoddard and Cutler¹³⁹ who reported 2 of the cases. Two others were reported by Rusk, and 1 each by Türk and von Hansemann. *Torula* is a pseudo-yeast and is distinguished from the true yeasts by its absence of endospore production, by the fact that it does not produce mycelium, that it usually does not ferment sugars and that it reproduces itself only by budding, but is more pathogenic for animals than true yeast. The lesions produced resemble those caused by the tubercle bacillus and are generally located in the central nervous system. Pierson's case was in a laborer, aged fifty-seven years, who was born in New York but who had resided in California for forty-five years. The patient was admitted with a diagnosis of senile dementia, and also on account of a burn. He died about a month after admission to the hospital and typical lesions were found in the brain, cord, and also in the lungs.

Trench Fever. This subject has been one of the most important in its relation to the Expeditionary Forces in Europe, so much so that

¹³⁷ Journal of Infectious Diseases, January, 1918, p. 53.

¹³⁸ Journal of the American Medical Association, December 29, 1917, p. 2179.

¹³⁹ *Torula Infection in Man*, Monograph 6, Rockefeller Institute for Medical Research, January 31, 1916.

there are two commissions, one American and one British, appointed to investigate this infection. The American committee is headed by Strong, aided by Swift, Opie, MacNeal, Baetjer, Pappenheimer, Peacock and Rapport. Their report is published by the American Red Cross and printed at the office of the Oxford University Press, and comprises nearly 450 pages. At the present time it is not possible to give any accurate statistics regarding the extent to which trench fever has prevailed in the different armies, but the fact that it is a disease of grave importance from a military standpoint has been brought out by the contributions of Grieveson, Muir, McNee and Byam, the last-named heading the English Commission, the results of whose investigations are noted below.

The American Red Cross Commission were able to prove a certain number of things in regard to the disease. In the first place, that it is a specific infection and is not a modified form of typhoid or paratyphoid as some have supposed, and is not related to these diseases from an etiological standpoint. The organism causing the disease is a resistant filterable virus and is present particularly in the plasma of the blood, and such plasma when inoculated into healthy individuals will produce the disease. The commonest means of transmission is by the body louse, either by biting or produced artificially by scarifying the skin and rubbing in a small amount of the infected louse excreta. They also demonstrated that a man may be free of lice at the time he develops trench fever, the lice that infected him having left him some time previously as host, and that a louse need only remain on an individual for a short time in order to infect him. The virus of the disease is at times present in the urine and the sputum, and the disease may be produced in man at such times through the scarified or otherwise abraded skin. This leads to the necessity of the urine and sputum being sterilized to reduce the possibilities of accidental infection. The most important means of preventing the disease is to keep the soldiers free from lice, and the commission recommends that all patients should be disinfected as completely as possible upon their entering the hospital and all clothing and blankets should be sterilized at moist heat at a temperature not below 70° C. for half an hour.

The disease was first noted in 1915 and 1916, the first descriptions being by Graham¹⁴⁰ who described it in Flanders and France; other important early studies are those by Hunt and Rankin,¹⁴¹ McNee, Brunt and Renshaw,¹⁴² who gave it the name trench fever. Important studies were also made by Herringham.¹⁴³

There are a number of descriptions of intermittent fever in the literature under the various titles of Vollenhian fever, quintan or five-days' fever, Polish fever, Russian intermittent fever, Meuse fever, Hiss-Werner disease, shin-fever, and shank fever, but it is not at all clear that all these descriptions refer to the same disease, and it is possible that mild forms of typhus, relapsing fever, spirochetal jaundice, or even paratyphoid fever, may be included.

¹⁴⁰ *Lancet*, September 25, 1915, p. 703.

¹⁴¹ *Ibid.*, November 20, 1915, p. 1133.

¹⁴² *British Medical Journal*, February 12, 1916, p. 225.

¹⁴³ *Ibid.*, January 19, 1918, p. 91.

The literature of the so-called five-day fever has been reviewed by Ceconi.¹⁴⁴ He defines the disease as an acute infection transmitted by the louse to man, occurring in epidemics or sporadically, and characterized by periods of fever or pain which may last from twenty-four to forty-eight hours and which recur periodically every six or seven days. The writers of antiquity, Hippocrates, Galen, Avicenna, and others, have described fevers occurring more or less regularly at intervals of from five to seven days, and these have generally been set down as malarial infections. This disease, as recently described, was discovered by the Austrian and German physicians in the region invaded in Russia. The cases observed prior to the war were set down by local physicians as malaria. The disease has been given various names: Volhynica fever (Hiss); Russian malaria (Moltrecht); five-day recurring fever (Müller); Ikwa fever (Stiefler and Lehdorff); tibialgic fever (Sachs). It has also been regarded as a special form of influenza occurring in the trenches, hence the title Polish influenza (Grätzer). The first observations came from the Volhynian sector and Poland, and later it was found in the East when the French troops and the Austrians were in the Trentino, and then among the Italian troops. The disease has been noted not only in Flanders and France, but in Salonica, in Mesopotamia and in Italy, and in Germany and Austria. It is difficult to state whether the previous descriptions of recurring fevers that have been described in earlier European wars are this disease or malaria, or some of the other recurrent febrile affections. McNee is of the opinion that this disease is unlike any reported in other wars, and it is barely possible that it may have been introduced by some of the Colonials.

There is at present no specific method for laboratory diagnosis of the disease, but laboratory methods are of value in differentiating other infections, such as malaria, the typhoids, and so on. Neither the *Spirocheta recurrentis* nor the *Leptospira icterohemorrhagica* has ever been encountered in trench fever cases.

The *incubation period* varies according to the method of inoculation and size of the dose employed, the limits being between five and thirty days. With intravenous injections of the filtrate, it has been from five to twenty-two days; with intravenous injections of the blood, from five to twenty days; with scarifying with urinary sediment, from thirty days; and from scarifying with louse excrement, from seven to eleven days. When the disease is produced by the louse, the intervals vary from fourteen to thirty-eight days from the time the louse was first placed upon the patient. The incubation of the disease by lice that were known to be infective from the time they were placed upon the experimental subject has been from fourteen to thirty days. It will not be necessary to give in detail the various steps taken in the investigation.

Anyone especially interested should consult the report, but there are a number of points of very considerable interest that may be noted. *The virus* is not only filterable but resistant. It is therefore to be compared to that of other diseases, such as hog cholera, African horse

¹⁴⁴ Il Policlinico, Sezione Pratica, November 18, 1917, p. 1381.

sickness, etc. It was found that the virus resisted a temperature of 60° C., moist heat for ten minutes, and is fully virulent for thirty minutes at that temperature, but is killed at a temperature of 70° C. for thirty minutes. Obviously, therefore, a temperature of 55° C. for thirty minutes, which destroys the louse and its ova, is not sufficient to destroy the virus of trench fever which may be present on the under-clothing of patients. As far as is known, the disease affects only human beings. The Commission state that the outlook of applying a method of vaccination does not appear to be particularly hopeful, but it might be possible to attenuate the virus and by experiment to determine its efficacy as a vaccine.

There have been a number of observations made regarding the *etiology of the disease*, McNee, Brunt and Renshaw regarding it as due to an intracorpuseular parasite, but they were unable to demonstrate such an organism, nor has anyone else. Houston and McCloy suggest an enterococcus and while they isolated this organism from several cases, others have not been able to do so. Dimond described a hemogregarine which he isolated from the venous blood and in material from splenic puncture and also from liver and lung puncture. These observations have not been confirmed, but Henry has found similar organisms in water. Sundell and Nankivell observed a spirochete in the urine of trench fever patients, especially about the sixteenth day of the illness, and this organism has also been noted by others, but apparently does not bear any relation to the disease. His, in the Volhynian fever, described diplococci with short rods with polar staining, and other German observers have described organisms in connection with it. The Commission, after very painstaking studies, have been unable to isolate any organisms which could be taken to have any relation to the etiology of the disease. A few bodies similar to those described by German investigators were occasionally encountered in the stained blood specimens, but similar organisms were also found in specimens of normal blood.

Mice, rats and guinea-pigs inoculated with the blood did not show any disease, and the Wassermann reactions were almost uniformly negative. The virus was found to be filterable in at least one stage of its life cycle, and in this respect resembles the virus of typhus, phlebotomous and dengue fevers.

The Commission demonstrated that the disease is transmitted by the louse, and made an announcement of this fact in March, 1918. Previous to this time there had been considerable difference of opinion regarding the methods of spread of the disease, but it was pretty generally thought that the disease was carried by flies or parasites found in the trenches. Some thought mice or rats were responsible, and there has been a considerable amount of speculation regarding the spread by the body louse, but until the Commission's experiments this widespread belief has not been experimentally demonstrated. Davies and Weldon¹⁴⁵ apparently performed the first experiments and they produced the disease by louse bites, but their observations were not controlled nor repeated, and no

¹⁴⁵ Lancet, February 3, 1917, p. 183.

very full description of the disease or temperature chart was published. Weldon was engaged in laboratory work with presumable trench fever specimens, and it is thought that he might have been infected. They deserve, however, the credit for having been the first to make the experiment. Pappenheimer and Müller also made experiments with lice, and their observations were not published, but appear at the end of the Commission's report.

The lice were fed upon trench fever cases and then upon three human beings; two of these remained healthy while the third developed a mild attack of what was supposed to be trench fever. Observations made by the Commission regarding the transmission of the disease were done in a sufficient number of instances to insure accurate results, and the experiments were carefully controlled. It was demonstrated that the disease was transmitted in this manner, but that the lice naturally hatched by eggs laid by lice that had fed on trench fever cases did not transmit the disease. It was also demonstrated that a louse could be away from trench fever cases as long as thirteen days and still be capable of infecting human beings. Apparently, after biting an infected individual, six or seven days must elapse before the louse becomes infective for man, which suggests that the virus goes through some intermediate cycle within the body of the louse, as ordinarily the louse does not retain the remnants of its food for more than a period of several hours, excreting it with its next meal.

As regards the *blood transmission experiments*, it may be stated that the disease was reproduced in 23 volunteers by the injection of the whole blood or one of its constituent elements. The incubation period varied from five to seven days when the blood was taken during the first three days of the disease. In 3 instances when it was taken during the first relapse, the incubation period was prolonged to thirteen days in 2 cases, and to twenty days in the third case. With citrated whole blood, which was kept out of the body for several hours, the incubation period was somewhat delayed, eleven days. The best results were obtained from the whole plasma, in which, with a series of 5 cases, 100 per cent. were positive, with an incubation period of six to seven days.

The *clinical history* of trench fever is interesting, maybe because at the present time there is no definite method of making a diagnosis. It is quite probable that the variety of description met with in the literature is due to inclusion of other diseases with it. The soldiers are generally admitted with P. U. O. (pyrexia of undetermined origin), and when the temperature chart showed definite relapses every five to seven days, or a short course of fever with a single intermission, the diagnosis is fairly certain, but, when the charts resemble those of typhoid or other diseases, it is difficult to make a diagnosis without excluding the disease for which it may be mistaken. The Commission made a study of the cases which were produced experimentally.

As regards the *prodromata*, many of the soldiers who contracted the disease in the trenches know almost to the hour when they were taken ill, having generally a chill, dizziness, and headache and prostration. Others, however, gave a history of malaise or respiratory symptoms,

such as sore-throat or colds for a time before the onset. Colds, however, are so frequent that whether these symptoms belong to trench fever or not is a question.

In the experimental subject, as far as the prodromata are concerned, they fall into three classes: (a) Those showing no unusual features until the onset; (b) those showing symptoms within a period of twenty-four hours before the onset; (c) those showing symptoms or signs of a more remote period than the day before the onset. A little more than one-third of the cases come under the second heading and the most frequent symptom complained of is frontal headache, usually in the frontal region, but most always involving the entire head. This is not severe enough to keep the patient from duty. Sometimes pain is complained of in other parts of the body, as the abdomen, arms and back of the leg. Chilliness is met with in some. In the third group, headache was also the most frequent symptom and in these cases the incubation period was prolonged, that is, twelve days or more. The headache occurred daily or at irregular intervals, and sometimes there appeared to be a periodicity to the recurrences. Sometimes there was slight malaise, enough to prevent the patient from joining in the activities of the other men. Occasionally, there was a slight rise of temperature during this period.

The *onset* does not differ from any of the infections, but, as remarked before, when the disease is contracted under natural conditions, colds and bronchitis and sore-throat help to confuse the picture. In the experimental cases almost all developed the disease completely within a period of twenty-four hours. The headache increases, or, if the onset is sudden, there may be a chill which varies in intensity from a severe rigor to merely chilly sensations. In nearly half the patients the onset occurred during the afternoon or evening, but it may come on at any time during the day or night. There is a very marked weakness and prostration, dizziness and even fainting.

These symptoms separate the disease from the other acute infections commonly met with among soldiers, except lobar pneumonia and three-day fever. As usual, there is anorexia, nausea and sometimes vomiting. In some there were sore-throat, cough, and in others there was a more or less marked bronchitis. When the disease is contracted in the trenches there is often increased frequency in urination. This occurred only twice in the experimental subjects. Photophobia was occasionally observed, and pain in the muscles of the legs has been described as shooting from the toes up the legs and to the back. A certain number complained of shin pains early, but these more often occurred later in the disease; this may be due to the fact that the patients were not immediately put to bed and kept there, as the shin pains were often brought on after exertion. Diffuse abdominal pain was common, but at other times it was more localized, closely resembling acute appendicitis, and not infrequently there was distinct pain in the splenic area.

The *physical examination* at the onset showed a distinct toxic condition, with more or less prostration. When moving in bed, the patients did so carefully, as if trying to protect their muscles. The eyes showed

marked conjunctival congestion, pain on rotation and a distinct nystagmus on looking sharply to the right or left. The tongue was coated. In many cases the typical rash was seen on the chest or abdomen a few hours after the onset, and within a few hours' time the spleen was enlarged in about 25 per cent. of the patients. The course of the fever is described below in the report of the British Trench Fever Commission.

In the experimental cases there are many which would not fit into any of the three courses which they describe. A pink-eye or conjunctivitis was present in about 95 per cent. of the patients, coming on early and with each relapse, and was frequently present several hours before the fever recurred. In most of the cases there was no discharge.

The trench fever *rash* is described by Drummond of the British Commission as consisting of red macules ranging from 2 mm. to 1 cm. in diameter, usually round, but may be more diffuse in outline, the color at the margin fusing gradually into the color of the surrounding skin. The color disappears on pressure, but reappears in from two to five seconds when the pressure is removed. In the majority of cases no infiltration can be felt, but rarely the spots are very slightly raised and slight infiltration is noticeable. They were never petechial in character. Each macule generally lasts twenty-four hours, sometimes only six hours, and sometimes two or three days. In those of long duration a faint pinkish or brownish pink color is left before it completely disappears. The rash is most often seen on the anterior surface of the chest between the costal margin and the transverse nipple line, and on the lower quadrants of the abdomen. Sometimes it may cover the trunk from the neck to the legs. It may also occur on the back, and may rarely be noted on the extremities, and rarely, if ever, occurs on the face. These spots usually disappear during afebrile periods and recur with the recurrence of the fever. The rash is not present in all the cases.

The *spleen* was enlarged in 85 per cent. of the experimental cases and tenderness was noted in 40 per cent. The enlargement of the spleen may occur at practically any time during the course of the disease. The pains and tenderness of the head, back, neck, abdomen and extremities are the most marked features, with the pains in the shins that led to the name of *shin-bone fever*. When the disease is contracted under natural conditions and the soldier is on duty and moving about, the shin pains may be of a very extreme type, so that the weight of the bed-clothes cannot be borne.

The *disturbances of circulation* belong chiefly to the convalescents and there has been considerable written on the relation of tachycardia, D. A. H. or the effort syndrome, to trench fever. This may be due to the trench fever virus having a selective action upon the heart muscle, and, inasmuch as trench fever is the most common and striking infectious disease in some of the armies, it would be naturally associated as the predominant cause of soldier's heart. Occasionally, during the course of the disease there may be a picture somewhat resembling paroxysmal tachycardia with precordial pain and hyperesthesia, and dyspnea, even when the patient is in bed. The general course of the pulse in the first two or three weeks is parallel to the temperature curve;

but later, when the temperature was normal or only slightly increased, the pulse-rate was not infrequently above the temperature curve. Among the experimental cases, up to the time of the report, there was no disturbed action of the heart after the infection was overcome, but this may have been due to the fact that the subjects were carefully chosen and where there were symptoms of cardiac weakness previously, the men were not inoculated. The soldiers were young, vigorous and had not had their vitality lowered by long duty in the trenches or exposure.

After the patients were up and judged to be in especially good condition to be exercised, they were given the exercises suggested by the British Commission for the classification of the heart among soldiers, and if there was an unusual tachycardia, with return of any symptoms, the time was not increased, and, if the symptoms persisted, the patient was put to bed. An exercise chart of each case was kept noting the dyspnea, giddiness, pain, fatigue, headache, cyanosis and general condition. When there was nothing more than slight dyspnea or other slight symptoms, the extent of the exercises was increased, but if there was dyspnea, headache, or fatigue, the exercises were not continued until the symptoms disappeared. After the graded exercises the men were sent on a route march of five miles without their packs, and if they made these route marches without symptoms, they were sent out in heavy marching order. After they had marched heavily loaded for one hour, they were classified as A1 men.

The exercises recommended by the British Commission were as follows:

CLASS A. FIFTEEN MINUTES.

Heels raise, feet close.
Head backward bend.
Hips firm, arms bend, arms upward stretch.
Trunk turning with feet closed.
Foot sideways place.
Trunk bending sideways.
Trunk forward bend.

CLASS B. FIFTEEN MINUTES.

Heels raise and knees bend.
Arms sideways stretch, one arm upward, one arm downward stretch.
Trunk turning, feet apart.
Feet close and full open.
Slow march.

CLASS C. FIFTEEN MINUTES.

Heel raising and knee bending quickly.
One arm upward, one arm downward stretch.
Foot placing sideways.
Trunk bending sideways.
Trunk backward bend.
Trunk forward bend.
Slow march.

CLASS C. FIFTEEN MINUTES. PART II.

Arms forward bend.
 Trunk turning.
 Knee raising
 On the hands down.
 Quick march.
 Knee raising quick, mark time.
 Slow march.

CLASS D. THIRTY MINUTES.

Heels raise, knees bend, arm stretching sideways.
 Head backward bend.
 Arm swinging upward.
 Trunk turning quickly.
 Foot placing sideways.
 Leg placing sideways.
 Trunk bending sideways quickly.
 Lying on the back down, leg raising.
 On the hands down, arms bend.
 Trunk forward bend, arm stretching sideways.
 Knee raising, quick march.
 On alternate feet hop.
 Upward jumping.
 Slow march.
 Arm raising sideways, upward, sideways, downward.

The *differential diagnosis* of the disease is made by carefully following the case; from influenza usually by the scarcity of respiratory symptoms at the onset, by the rash, by the peculiar hardness of the spleen, by the areas of tenderness and pain, and by the relapsing character of the fever symptoms. From typhoid and paratyphoid it may be distinguished by the more sudden onset and absence of intestinal symptoms, presence of tender areas, the leukocytosis in most cases, by the absence of typhoid or paratyphoid bacilli in the blood, stools and urine. The agglutination curve is of use when it remains flat. In cases of trench fever it may rarely give a curve as in typhoid according to Dreyer's standard. In malaria there is a different temperature course, and the blood examination will finally settle the matter. In relapsing fever it may be easily transmitted to rats or mice, and it yields quickly to salvarsan, while trench fever does not. Dengue fever and trench fever have a very similar onset and distribution of pain, but the duration of dengue is short, with an intermission or remission on the third to fifth day, and the rash often appears on the fourth to sixth day and is macular, mobiliform, and scarlatiniform. The blood shows a leukopenia, while in trench fever there is a leukocytosis. In typhus fever there is a gradual step-ladder-like rise in temperature, and the toxic symptoms increase in intensity and severity. The rash appears about the third to fifth day and is macular, becoming petechial, and the disease is often fatal. In

trench fever the toxic symptoms are comparatively mild and decrease, and it is never fatal. Atypical cases of typhus may, of course, be incorrectly diagnosed.

The course of the fever varies. The preliminary report of the committee, consisting of Beveridge, Bradford, Herringham and Leishman¹⁴⁶ shows that they believe there are three forms of fever of unknown origin now prevalent: (1) The relapsing, or trench fever; (2) a fever with a single short initial bout; and (3) a prolonged initial fever. These three are indistinguishable from one another by any other symptoms than the course of the pyrexia. All exhibit similar pains, all have enlargement of the spleen, are apt to be accompanied by tachycardia, and none show intestinal or renal symptoms of any importance. These three forms are evidently the different manifestations of the same disease.

The pyrexia varies considerably, and the committee was not able to find correlation between the fever curve and the clinical course. There are two forms of fever, the first an irregular, remittent and intermittent fever, lasting rarely for more than four weeks; the second is a definitely intermittent fever, often showing regular periodicity and sometimes extending over a period of several weeks. The first form usually precedes the second, although the initial attack may not be recognized. With the first form three types of curves were seen. In the first the fever lasted about three days, with a maximum temperature of 104.4° , followed by recovery. The second was a similar febrile disturbance followed, most commonly on the sixth, seventh or eighth days, by a relapse, with a distinct afebrile interval. Following this there may be irregular fever. The third, a continuance, more or less complete, of the original fever, into the relapse and often followed by a preliminary period of irregular fever.

It is interesting to compare the findings of the British Committee headed by Byam. They were able to produce the disease in 17 instances, in 13 of which there was a sudden onset, and in 4 the disease developed gradually. Of these, 8 men were in the hospital at the time of the report, and 3 of them showed evidences of developing a chronic form of the disease. Six have returned to some form of useful work, and 1 had symptoms of disordered heart action on leaving the hospital.

The Committee determined that the whole blood, taken from the fever cases up to the fifty-first day of disease, when injected intravenously, was capable of reproducing the disease. In these observations the incubation period varied greatly, from five to twenty days. The virus in the circulating blood is destroyed by the addition of distilled water in large quantities. They also found that the bites of infective lice alone do not produce trench fever, but the excreta of the lice when applied to a broken surface of skin readily produce trench fever. The incubation period of such cases is very constant, averaging eight days. When the lice are allowed to feed on trench fever patients, the excreta passed by them is not infective until at least seven days have elapsed from the beginning of the feeding. From this it is taken that there is a

¹⁴⁶ British Medical Journal, January 19, 1918, p. 91.

developmental cycle in the louse, or a period during which the organism multiplies. When the lice are infective they remain so until at least the twenty-third day from the date of their infection. The virus of the disease is rather resistant, inasmuch as that contained in the infected louse excreta is capable of withstanding drying at room temperature, exposure to sunlight, keeping for not less than sixteen days and heating to 56° C. for twenty minutes; that the virus is not of the spore-bearing variety is evidenced by the fact that a temperature of 80° C. for ten minutes destroys it. When the lice are infective the disease may be produced by merely crushing the parasites on the broken skin, but active trench fever blood in the equivalent to eleven lice will not produce the disease when applied in the same manner. The excreta of normal lice is not capable of producing the disease and the lice infected with trench fever do not transmit the disease to their offspring.

The Committee was of the opinion that the transmission of the disease does not take place by mouth or by inhalation. They have also determined that the number of individuals naturally immune is exceedingly small and that people of advanced age are capable of being infected. The immunity produced by an attack of trench fever is not permanent, and may persist only as long as there is evidence of the disease. The virus may linger for a long time in the blood of an individual having the disease, and it has been found that lice fed on a patient during the febrile period become infected even as late as the seventy-ninth day. There are also some interesting observations which tend to show that the different varieties of trench fever are not due to the source of infective material, but to the differences of the individual having the disease; thus the blood of a patient without pains in the extremities when injected intravenously into another individual produces an attack of the relapsing type of the disease with marked shin-bone pain, and the same is true as regards the splenic enlargement and the type of pyrexia and the other symptoms.

Byam¹⁴⁷ gives the following summary of the results of the experimental work of Trench Fever Investigation Committee under Bruce:

"1. The whole blood from febrile trench fever cases up to the fifty-first day of disease, when injected intravenously, was capable of reproducing the disease. *The incubation period of such infections varied greatly—from five to twenty days.*

2. The virus as contained in the circulating blood was destroyed by the addition of distilled water in large quantities.

3. The bites alone of infective lice did not produce trench fever.

4. The excreta of infective lice when applied to a broken surface of skin readily produced trench fever. *The incubation period of such infection was remarkably constant and averaged eight days.*

5. The excreta of lice fed on trench fever patients were not infective until the expiration of not less than eight nor more than twelve days from the commencement of the feeding on trench fever blood, thus indicating a development cycle in the louse or a period during which the organism multiplied.

¹⁴⁷ British Medical Journal, May 25, 1918, p. 591.

6. Once lice were infective they remained so until at least the twenty-third day from the date of their infection.

7. The virus of trench fever, as contained in infected louse excreta, was capable of withstanding drying at room temperature, exposure to sunlight, keeping for not less than sixteen days, and heating to 56° C. for twenty minutes.

8. 80° C. for ten minutes destroyed the virus, which was therefore not a spore-bearing organism.

9. The bodies of infected lice when crushed upon the broken skin were capable of producing trench fever. When lice became so infective remained to be determined.

10. Infection probably did not take place by the mouth or by inhalation.

11. The excreta of lice were not normally capable of producing trench fever.

12. Trench fever infected lice did not transmit the disease to their offspring.

13. There was a possibility of some attacks of trench fever being afebrile throughout.

14. The percentage of individuals naturally immune to trench fever was exceedingly small.

15. Old age was no bar to infection.

16. Such immunity as resulted from an attack of trench fever was not permanent, and might only persist for so long as the individual showed evidence of the disease.

17. Even as late as the seventy-ninth day of disease a patient's blood might remain infective, and be capable of infecting lice fed on such a patient while febrile.

18. The different varieties of trench fever resulted from differences in the persons infected rather than in the source of infection.

As the experiments had been but few, some of these findings might be modified by future work.

THE ASSOCIATION OF RICKETTSIA BODIES WITH TRENCH FEVER. Arkwright, Bacot and Duncan¹⁴⁸ have described a constant presence, after a suitable lapse of time, of certain bodies in lice which are fed on trench fever patients. These organisms are very small, often but 0.3 by 0.3 microns in size and approaching the limits of filterability by a Berkefeld filter. These bodies can, to a great extent, be separated from larger bacteria in an emulsion of excreta in salt solution by differential centrifugalization. These bodies do not make their appearance in the bodies of lice that have been infected until from the fifth to the twelfth day. These organisms are similar to those described by Ricketts, in 1909, in Rocky Mountain spotted fever; by Ricketts and Wilder, in 1910, in typhus fever; and by Töpfer, in 1916, in trench fever.

Eye Changes in Trench Nephritis. Kirk¹⁴⁹ has made a short report on this subject based on a series of cases studied in Malta. The patients were chiefly young active soldiers between twenty and thirty, a few

¹⁴⁸ British Medical Journal, September 21, 1918, p. 307.

¹⁴⁹ Ibid., January 5, 1918, p. 7.

were older. Most of the cases were of the severer acute form, and on their admission to the hospital were seriously ill. The changes consisted almost invariably of retinal congestion, with large pulsating veins, but there were no signs of any patches of exudation or nerve involvement. Some weeks later, however, on the examination of one or two patients who had complained of eye symptoms, patches of retinal exudation and nerve swelling were found. The whole series of cases was reexamined, and in the convalescent cases but few changes were noted; in the second series of those who had not done so well and in which there was slight albuminuria, edema and breathlessness, over two-thirds showed minor retinal changes and one a fairly severe neuroretinitis. In the very severe cases that had not cleared up, two-thirds of the cases showed very definite retinal changes. The spots of exudation were generally in the disk and near the macular area. Hemorrhages were not common, and those seen were of the small punctate variety and not of the striate or flame-like character. The changes in the disk varied from a definite swelling to merely indistinct edges. Kirk is of the opinion that the retinal changes will not affect the prognosis except insofar that the severer the changes the severer the case, though by no means necessarily so.

Trichinosis. Meyer¹⁵⁰ has reported 3 cases with symptoms of meningitis with the finding of trichinae larvæ in the cerebrospinal fluid. Van Cott and Lintz (1914) reported the finding of trichinae in the spinal fluid, and since then their observations have been confirmed by a number of observers. Bloch, who was one of those confirming the observations on the spinal fluid, emphasizes the fact that the organisms may be present without any symptoms referable to the brain and cord, and Bloch and Hassin have reported a case in a young man who developed a case of left-sided hemiparesis and showed exaggerated knee-jerks, bilateral Babinski and left-sided ankle-clonus. No organisms were found in the spinal fluid in this case. Meyer's cases were in children, one a girl, aged six years, one a girl, aged twelve years, and one a boy, aged eight years. These patients all had symptoms and signs of meningitis. The spinal fluid was clear and under increased pressure, the cell count was as high as 240 and as low as 40 per cubic millimeter. The Nonne reaction was positive, the Ross-Jones test negative, and a copper solution was reduced, while albumin was absent with the nitric acid test. He considered these tests as evidence of meningeal irritation. In 2 of the cases the trichinae were demonstrated in the fluid. It is particularly interesting to note that these children presented symptoms and spinal fluid findings that might readily be mistaken for poliomyelitis. An important point in the diagnosis is the presence of edema, which the author states is not like the ordinary type, which pits on pressure, but in these cases is rather hard, glistening and board-like, particularly over the extremities. There is a high eosinophile count in the blood and, of course, the diagnosis would be confirmed by finding the organism in the cerebrospinal fluid.

¹⁵⁰ Journal of the American Medical Association, March 2, 1918, p. 588.

THE SERUM THERAPY OF TRICHINOSIS. In 1916, Salzer claimed to have secured beneficial results in man and in animals used for observation by the serum of patients recovered from the disease. He also suggested that injections of serum are prophylactic against trichinosis. In the following year, Schwartz was not able to substantiate these claims, and now Hall and Wigdor¹⁵¹ have repeated the observations and their findings tend to confirm the opinion of Schwartz and to disprove Salzer's claims, but they believe that while some of Salzer's contentions may be erroneous, he may be right in part. They found that serum of animals convalescent from trichinosis when injected into other animals, or fed to them mixed with trichinosis meat, does not inhibit the customary development of these organisms. They believe, however, that the serum may be of decided value in combating the toxic features of trichinosis, but the number of cases in the United States is so small that such a serum would have to be distributed from some central plant and not through the usual market channels. The subject is one which is certainly worthy of further consideration.

Typhoid Fever. **TYPHOID IN A COMPANY OF IMMUNIZED SOLDIERS.** Bradbury¹⁵² has reported the occurrence of 4 cases of typhoid in a company of 175 men in the Engineers of the American Expeditionary Forces. These men had been immunized but five months before. It is not definitely known how long the immunity conferred by typhoid inoculations lasts, but it is known that some persons either do not develop an immunity or retain it but a short time. These cases were doubtless due to a carrier working in the kitchen of the company, but this was not definitely determined. Infection was limited to men eating from one mess kitchen in which 7 possible carriers had been working. Men of another company, eating at their own mess, but using the same water and food prepared separately, did not have any infection, and there was no typhoid in any of the British troops using this water. Whether or not the fact that the men had had six weeks of hard work with long hours and irregular meals, and that they may have been subjected to an extremely heavy dose of infecting bacilli, had anything to do with the infection is not known. The lesson to be learned is that the individual who has been immunized should not be subjected to the risk of contracting the disease if it is possible to avoid it.

THE ATROPINE TEST IN THE DIAGNOSIS OF TYPHOID INFECTIONS. In 1916, the British Medical Research Committee issued a monograph prepared by Marris.¹⁵³ The normal individual or those with diseases other than typhoid respond to the administration of atropine and show an increase in the heart-rate. In typhoid infections this increase in rate either does not occur or occurs to a lessened degree. The toxins of the typhoid group are apparently antagonistic to the action of atropine. In making the test, the patient lies horizontally and should remain at complete rest until the test is completed. It should not be employed until at least one hour has elapsed after the last meal. The pulse-rate

¹⁵¹ Archives of Internal Medicine, November, 1918, xxii, p. 601.

¹⁵² Journal of the American Medical Association, August 17, 1918, p. 532.

¹⁵³ British Medical Journal, 1916, ii, p. 717.

is counted minute by minute until it is found to be steady, which usually occurs within ten minutes, and then $\frac{1}{33}$ grain of atropine sulphate is injected, preferably in the triceps region to ensure rapid absorption. After twenty-five minutes the pulse is again taken, minute by minute, until it is clear that any rise which may follow the injection has passed off. Fifteen to twenty minutes may be necessary when the pulse-rate is the same as at the first count. The test is useful in typhoid and the paratyphoids A and B. Marris places the line of demarcation a matter of fifteen beats—that is, if the pulse is raised less than fifteen beats for a minute it indicates a typhoid infection, whereas if the pulse is increased for more than fifteen beats it is against the diagnosis.

Friedländer and McCord¹⁵⁴ have made a study of 228 cases of diseases other than typhoid and paratyphoid at Camp Sherman. Their results rather go to show that the method is not so valuable as has been supposed, inasmuch as a series of 170 non-typhoid patients gave positive results. The 13 different diseases included in this group were chiefly scarlet fever, measles and pneumonia, and, to a lesser degree, influenza, tonsillitis and a few others.

Mason¹⁵⁵ has made the test in 63 cases of typhoid or paratyphoid at the Royal Victoria Hospital in Montreal. Of these, 56 were typhoid as shown by blood cultures or Widal reactions. Five were paratyphoid B and the remaining cases were clinical typhoid, but this was not confirmed by any bacteriological or serological findings. There was no variation in the sexes, although most of the patients studied were men. Eleven of the 63 failed to give the atropine reaction, which Mason believes was due to the considerable restlessness of the patient. When present, the reaction was found on the tenth day and disappeared about the thirty-first day of the infection. In 43 patients suffering with conditions other than typhoid, 3 gave positive reactions. Mason expresses the opinion that the test is of considerable value.

A Protective Therapy for Varicella. Hess and Unger¹⁵⁶ have made some observations on this point which was brought out by Kling¹⁵⁷ in 1913. Kling states that he was able to immunize children by one application of the contents of the vesicles to the abraded surface of the skin after the manner in which the von Pirquet tuberculin reaction is carried out.

Hess and Unger used the following technic: In each instance only vesicles, and not pustules, were made use of; the surfaces were very gently washed with sterile salt solution and the contents allowed to ascend into capillary tubes. As much as possible of the clear fluid was obtained and was immediately mixed with sterile normal salt solution. This diluted virus was diluted still further with salt solution before it was injected. The dosage was entirely empirical, three-quarters of an inch, as measured in the capillary tube, was used in each instance. The transference of syphilis was guarded against by use of the Wassermann

¹⁵⁴ Journal of the American Medical Association, May 18, 1918, p. 1435.

¹⁵⁵ Archives of Internal Medicine, January, 1918, p. 1.

¹⁵⁶ American Journal of Diseases of Children, July, 1918, p. 34.

¹⁵⁷ Berliner klin. Wehnschr., 1913, I, p. 2083.

reaction. Thirty-eight children, about three or four years of age, were vaccinated intravenously after this method, and, in spite of the epidemic which prevailed and the well-known contagiousness of this disease, none of the children developed any local or general signs suggestive of the disease. During the course of the epidemic all were exposed, and one developed chicken-pox thirty-six days after the inoculation.

Hess and Unger explain the fact that the children did not develop the disease on the theory that most viruses are able to bring about their specific diseases only when introduced into their natural paths, and when injected into unnatural routes an excessive amount of virus is used to call forth a specific reaction. In chicken-pox the lymphatic system is invaded and the virus apparently does not enter the body by means of the blood stream, so that this virus has not acquired the property of invading the organisms in this way. Similar observations have been made on animals in reference to smallpox virus. Applications of virus to the mucous membranes, as in the nasal secretion or the tonsils' secretion, did not always bring about an immunity.

SUMMARY OF PROTECTIVE IMMUNIZATION.

Mode of introduction of lymph.	Number of cases, ¹⁵⁸	Number subsequently in contact with chicken-pox.	Number of contacts developing chicken-pox.	Remarks.
Intravenous	38	38	1	Chicken-pox appeared in this case forty-one days following prophylactic therapy.
Intravenous (inactivated)	9	1	0	
Intracutaneous	16	5	1	No local reaction.
Subcutaneous	10	0	—	
Skin (von Pirquet)	3	3	1	Chicken-pox sixty-two days after immunization
Nostrils	3	3	2	Chicken-pox forty-four and sixty-two days after immunization.
Tonsils and mouth	3	3	0	
Tonsils, nose and mouth	4	0	—	

Vincent's Angina in an Unusual Form. As early as 1883, Miller, an American dentist working in Berlin, described, among other organisms found in the mouth, a fusiform bacillus occurring in association with a large spirochete; and, in 1894, Plaut contributed an article of value; and later, Vincent, between 1896 and 1905, made a number of extensive studies on the organisms and the lesions which they produce. The lesions are more or less suggestive of diphtheria, and while there have been a good many scattered observations, no particular attention was paid to the disease until it became apparent that large numbers of cases of sore-mouth or trench-mouth were noted among the troops. Last year I reviewed the article of Campbell and Dyas. Other observations along the same line have been made by Bouty¹⁵⁹ who assumed that 23 per cent. of all throat infections were due to this. McClintock¹⁶⁰ and

¹⁵⁸ There was no instance of signs or symptoms of varicella occasioned by the immunization.

¹⁵⁹ British Medical Journal, 1917, ii, p. 685.

¹⁶⁰ American Journal of the Medical Sciences, 1917, xliii, p. 256.

McKinstry¹⁶¹ and others have studied so-called normal mouths and found there are many healthy carriers of these organisms. Under certain conditions the disease may become very infectious and spread rapidly among those closely associated.

Two forms of the disease are encountered: One consisting of a thin, grayish-white pseudomembrane which generally starts on one tonsil and spreads until it covers a large area, and may suggest diphtheria. Bits of the membrane are easily removed and the surface left is ulcerated, red and bleeding. Perhaps of more common occurrence is an ulceration or necrosis of the tissues covered with a thick gray or yellow exudate which is easily removed, leaving the same bleeding surface. Eventually, large irregular ulcers are formed.

Barker and Miller¹⁶² have described a case of perforating ulcer of the hard palate due to these organisms, and the lesions were of more interest in that it resembled the lesions of tertiary syphilis. The patient was a man, aged forty-seven years, whose history was negative in every way. He noticed a small sore on the roof of his mouth and a small white spot, to which he paid no particular attention. This enlarged and in a few days became a painful ulcer. There was marked oral sepsis and gingivitis, a fetid odor to the breath and a well-defined punched-out ulcer about the size of a dime on the hard palate. The blood was normal, the Wassermann reaction negative, the smears from the exudate showed the *Bacillus fusiformis* and many coarsely-stained spirochete. The treatment consisted of local applications of dichloramin-T, and also some of concentrated arsphenamin solutions. The ulceration disappeared in a few days and there has been no recurrence.

Barker and Miller's article also goes into the description of the organism as well as the differential diagnosis. The disease may be apt to be mistaken for syphilis, diphtheria or tonsillitis. The last named is easily excluded by the appearance of the tonsil and marked constitutional symptoms, the leukocytosis, and, if necessary, by smears of the exudate. In diphtheria the membrane is more difficult to remove and may come away in one piece, and the throat smears show the diphtheria bacilli and cultures are positive. The organism described by Vincent may be seen in smears showing the diphtheria bacilli, but diphtheria bacilli are not found in any appreciable amount in the lesions of Vincent's angina. Should there be any question about the organisms morphologically a Gram stain will differentiate them, as the *Bacillus fusiformis* is negative and the *Bacillus diphtheriae* is positive. From syphilis the diagnosis can usually be made by the Wassermann reaction, although it was held by some that this was present in cases of Vincent's angina. Taylor and McKinstry¹⁶³ have studied the reaction in 55 cases of Vincent's angina. Fifty-three gave a negative Wassermann reaction while in 2 it was positive, both of which gave a previous history of syphilitic infection.

The disease can apparently be prevented by simple oral antisepsis, and numerous applications have been suggested for its cure after it

¹⁶¹ Practitioner, London, 1917, xcix, p. 507.

¹⁶² Journal of the American Medical Association, September 7, 1918, p. 793.

¹⁶³ British Medical Journal, 1917, i, p. 421; and *Ibid.*, 1918, i, p. 82.

has developed. The local application of arsphenamin, either in solutions or suspensions in glycerine, two or three times a day, is the best treatment, and most cases clear up in a few days. Fowler's solution has also been used, either alone or in combination with other drugs, and tooth washes composed of such combinations as that suggested by Bowman of $\frac{1}{2}$ ounce of wine of ipecac, 1 dram of glycerine and sufficient liquor potassii arsenitis to make an ounce, and used two or three times a day on the toothbrush. Or the solution suggested by Emrys-Roberts,¹⁶⁴ which consists of hydrogen peroxide, 5 fluidounces, wine of ipecac, 3 drams, glycerine, 5 drams and water to make 8 ounces, may be applied, and some have modified this by the addition of Fowler's solution.

TRICHLORACETIC ACID IN VINCENT'S ANGINA. This agent has been recommended by a number of different observers, with varying success. Gallaher¹⁶⁵ believes that it is a specific for the disease. His method is to use the drug pure, although others have recommended it in dilute solutions. He used a small applicator with cotton, the excess of the acid being removed with an ordinary blotter, after which the entire area is painted. When the tonsil is involved a thin applicator should be used to carry the acid to the depth of each crypt. After the parts have turned white, the remaining acid should be neutralized with a saturated solution of sodium bicarbonate. A second application may be made in two or three days, if necessary, but Gallaher has found that if applied carefully one or two applications suffice.

The Action of Antiseptics on the *Bacillus Welchii*. Taylor and Austin¹⁶⁶ have made a study of this subject. The recent observations on the chemical sterilization of wounds has resulted in a large number of contributions on the bactericidal action of the various antiseptics in general use. Without going into their experiments in detail, it may be stated that they found that Dakin's hypochlorite and chloramin-T solutions will protect pigeons against multiple fatal doses of the toxin of *Bacillus Welchii* when the antiseptic and the toxin are mixed *in vitro* and allowed to stand in contact for five minutes before injection. This detoxicating action of the solutions is also demonstrable in the presence of serum. They also demonstrated that phenol solution, 0.25 per cent., has no such action.

GAS GANGRENE AND ACIDEMIA. Wright and Fleming¹⁶⁷ bring forth some interesting observations on this subject. Wright has previously shown that the bacillus of Welch when cultivated in serum renders that medium acid, that the growth of the organism is opposed in normal blood fluids through the alkalinity and antitryptic power and the blood fluids become a very favorable culture medium when the alkalinity is changed by acid or their antitryptic power by trypsin, and especially by both together. He also showed that an animal killed and incubated after intravenous inoculation with the organism is associated with the development of a postmortem acidosis, and that in a living animal the

¹⁶⁴ British Medical Journal, 1917, ii, p. 359.

¹⁶⁵ Laryngoscope, July, 1918, p. 551.

¹⁶⁶ Journal of Experimental Medicine, 1918, xxvii, p. 375.

¹⁶⁷ Lancet, February 9, 1918, p. 205.

evolution of gas gangrene proceeds with a local and general acidosis, and that in man the characteristic toxemia of the disease is a very severe acidosis, and, furthermore, the immediate improvement of the patient can be clinically obtained by the intravenous injections of an alkali.

The authors just mentioned have shown that the growth of the organism is favored by a reduction of blood alkalinity, and the organisms can, by elaborating an acid, make for themselves more favorable conditions for growth at the site of infection and in the blood generally. The suggestions for treatment consist of giving intravenous injections of an alkali and following by lactate of soda administered by mouth in doses of 8 grams every four hours until the urine becomes alkaline. For the intravenous injections they suggest a 5 per cent. solution of sodium bicarbonate. This is sterilized, and they state that the fact that it is partly converted into carbonate during the sterilization did not make any material difference. The quantity of the solution given is 500 c.c. They suggest the lactate of soda, made by neutralizing lactic acid by soda, because it is well tolerated by the normal stomach, that it is absorbed very readily and converted into carbonate. If there is an operation, they call attention to the fact that chloroform should not be used as an anesthetic, but either warm ether or nitrous oxide with oxygen, the last by preference. For the local treatment of the tissues, they suggest a 5 per cent. salt solution, which they believe acts as a local lymphagogue.

DISEASES OF CHILDREN.

By FLOYD M. CRANDALL, M.D.

FOR the third time I am obliged to refer to the fact that, owing to war conditions, medical material from foreign sources has been very meager. During the first two years of the war, pediatric literature suffered particularly. Military medicine and surgery occupied much space in the medical journals, and pediatrics suffered. During the past year or two the fact seems to have dawned upon both physicians and laymen that there is a special reason for the conservation of child life. The destruction of adult life must be met by the saving of child life to avert, in a measure, the depletion of population of every nation involved in the great war. Certain phases of pediatric literature have not been neglected. In this country, general pediatric writing has been well up to the standard. Very little, however, can be drawn from France and England, and nothing from the central nations of Europe. The glamor of Teutonic medicine has gone, probably never to return. The medicine of the world was Germanized. Even under present conditions of mind, it cannot be denied that the plodding German mind added much to medical knowledge. It furnished much material to be worked over into practical use by logical intellects, which the German does not possess. It is to be hoped that a more rational and reasonable era is to dawn upon medicine. In few departments of medicine is there more opportunity for such reasonable measures than in pediatrics. During the late summer and fall the journals have been overfilled with papers on influenza, a subject which does not come within the scope of this article.

Standards for Growth and Nutrition. In an extended article on this subject, Holt,¹ of New York, summarizes the results obtained from charts giving the weight curves of over 50,000 boys of different nationalities of this country and abroad. Weight-to-age variations are so wide as to make this relationship of very little value when taken alone. The normal variations in the weight of healthy children of the same race are from 10 to 15 pounds between the sixth and tenth year, while from the tenth to the sixteenth year the range is from 20 to 40 pounds. In a private school for boys who come from the wealthiest homes, the weight range from the twelfth to the sixteenth year was from 40 to 50 pounds, all weights being taken without clothes and by the same physician.

The height-to-age variations are still less significant. Height is even more influenced by race and family inheritance than the weight. Children of the well-to-do classes exceed those of the less favored in height much more than they do in weight.

¹ Archives of Pediatrics, June, 1918.

The relation of height-to-weight is the only one which is important as indicating the state of nutrition, but here also considerable variation exists in healthy children. A child's nutrition may be considered below the normal when he is 10 per cent. below weight for his height between the sixth and tenth year, or 12 per cent. below from the eleventh to the sixteenth year.

The best guide to the state of nutrition, and more important than either of the foregoing, is the annual rate of increase in height and weight. The annual increase in weight is from 4 to 6 pounds a year from the sixth to the tenth year, while it rises to an average of 13 pounds in the fifteenth year. Girls gain at the same rate as boys up to the age of ten years, but surpass them for the next three years. The annual increase in height varies normally less than weight. The average increase is from $1\frac{3}{4}$ to 2 inches a year from the sixth to the eleventh year. It rises to its highest point in boys from the thirteenth to the sixteenth year when it is usually from $2\frac{1}{2}$ to 3 inches a year. In girls, it is highest from the tenth to the fourteenth year. As a rule, growth in height and weight is in healthy children along parallel lines. On insufficient food, growth in height may go on though there is loss in weight.

Observations on 1243 school boys between ten and sixteen years showed that they increased in weight $1\frac{1}{2}$ pounds more in six months from May to November than from November to May and that the gain in height was 0.38 inch more during the first-named period.

Holt says: "The point to be emphasized is that the normal curve is not a line but a zone, a much wider zone than we have appreciated." Bowditch made his observations twenty years ago, and it is said that children of this generation are taller than those of the previous generation. Griffith has spoken of the weight of the clothes. In boys and girls the weight of the clothes averages very near the same figures. Hess is probably right in supposing that the reason that we find more rapid growth during the summer months in these boys is because the time from May to October occupies the period of out-door life. The Dummerline scale should, perhaps, be mentioned, though Holt mentions it only to condemn it. Baker, of the New York Health Department, has had 170,000 children examined by this scale and reaches results that are quite at variance with those of Holt.

Effect of War on the Development of Growing Children. Some time ago a statement that 70,000 children in New York City went breakfastless to school was given wide publicity. In order to investigate the truth of this statement, a committee was appointed to make an intensive study of life conditions among school children in the poorest sections of the city. Some of the conclusions to be included in the report are outlined by Chapin.² A careful investigation was made of 1400 children. It was found that of these children 0.7 per cent. had no breakfast; 1.2 per cent. had had tea or coffee only; 0.6 per cent. had bread and water; and 48 per cent. had tea or coffee with bread or cake. The remaining 14.8 per cent. seemed to have an adequate breakfast. Thus it was

² Archives of Pediatrics, January, 1918.

learned that one-half of these children had started in the day with an inadequate breakfast. A certain number were inadequately fed during the remainder of the day; 2.8 per cent. having no meat or eggs, 12.1 per cent. having coffee or tea three times a day, and 28.1 per cent. having these beverages twice a day. This investigation brought out the important fact that poverty alone was not responsible for this defective diet. Of the 1400 children investigated, 10.4 per cent. showed marked malnutrition. Enlarged adenoids, bad teeth and swollen glands were very common, 45 per cent. having enlarged glands and 74.9 per cent. bad teeth. Although the food given these children was unsatisfactory, it was only one of the contributory causes of the unsatisfactory condition of these children. Poor housing, bad environment, ignorance and faulty management, were all factors entering into the problem. In investigating the problem of undernourishment at different periods, it was found that a study made in 1905 showed parental ignorance and lack of proper oversight were more important factors than inability to secure food. At the present time, rapidly mounting prices of all kinds of food seem to be assuming a more important place than other factors in the problem.

The investigations of the New York Association for Improving the Condition of the Poor showed that in 1915, the cost of food representing 65,000 calories for a family of five was \$5.84 a week; in November, 1917, it was \$8.97, an increase of three dollars in two years. A survey recently made by the New York City Department of Health, the Association for Improving the Condition of the Poor, and the Mayor's Committee showed that many families had dropped the use of milk entirely and that a considerable number had substituted, the use of condensed milk. A statistical study of wages showed that although wages had increased, the increase was not in proportion to the increase of the price of food. It seemed to be the rule for children of all stages that small family incomes and poor nutrition usually went together. The statistics of the Federal Children's Bureau showed that the minimum annual income of a family of five in New York, in 1917, was \$980 as compared with \$840 in 1915. At the same time it was shown that one-half the married men in New York were receiving \$15 per week or less, while \$17 was the minimum requirement. There is no question that the effect of all this upon the nutrition of many children has been marked.

A study of the nutrition of school children in New York was made in 1916, in the course of which 95,030 children were examined and graded according to the Dumfermline scale. According to this scale there are four grades, as follows: First grade means excellent, that is, the nutrition of a child is good; second grade means that a child falls just short of this; third grade means that a child requires supervision and is on the border-line of serious nutritional impairment; fourth grade means that a child requires medical treatment and that his nutrition is seriously impaired. It was found that of the 95,030 children examined, 30 per cent. belonged to the first grade; 59 per cent. were possible and were classified in the second grade; 0.08 per cent. were poor; and 0.3 were very poor. Mr. Frank Manny has made a similar investigation of the children in Public Schools 40 and 50, comprising 2538 children. Of

these, 21 per cent. were in the first grade according to the Dumfermline scale, 43 per cent. in the second grade, 24 per cent. in the third grade and 12 per cent. in the fourth grade. These were not among the worst schools. If further study showed the same relative proportions among the four nutritional grades it would mean that there are 120,000 cases of malnutrition that call for immediate attention and that 240,000 are on the border-line, that is, needing careful supervision. A study as to the number of children in the families represented by these families showed that the poorer nutritional cases were apt to be found in the larger families. Foreign-born children, however, gave a better showing than the native-born. There was no question as to the tendency to an increase of undernutrition under present conditions. It would seem that immediate steps should be taken to deal with this serious question.

Air Space Required by Institutional Children. The subject of air space and the ventilation of children's wards has been one of particular study by the Pediatric Section of the New York Academy of Medicine. The laws of New York, like those of other States, have made certain provisions in this direction. Specific specifications, however, have not been adequate. While specifying 600 cubic feet as a minimum, these laws in many instances have given local boards of health the power to reduce this allowance. This space has frequently been reduced to 500 feet or even less. It has been erroneously assumed³ that infants and children, because of lesser weight than adults, require a lesser amount of oxygen. In institutions the children remain in the same crib and ward practically during the entire twenty-four hours, and their attendants, who are not included in the same permit, help to vitiate the air of the ward.

Three main factors enter into the question of cubic space for an infant in a ward: (1) Space to afford reasonably pure air for respiration; (2) space to allow sufficient separation of the cribs in order to minimize air-borne infections; (3) space to avoid overcrowding, which operates to reduce the individual care which can be given to each infant by a limited number of nurses and attendants.

Respiratory need is but one factor in metabolism; equally important elements are the temperature of the air, its humidity, the barometric pressure and the rapidity of its motion. All these are determining factors in the heat expenditure of the body. According to Lusk, the heat production of a newborn infant is 2.6 times that of its mother, based upon calories produced per kilogram of body weight. The surface area per kilogram of a small body is two or three times greater than that of a large body. The smaller the animal or child, the greater the relative surface exposed for evaporation and for giving off or receiving heat. The infant and adult have relatively different needs because of the disproportion between the weight and surface area. The heat expenditure of a six months' old infant is 130 calories a kilogram of body weight, while that of a child eighteen months old is only 91 calories a kilogram.

The chief organ concerned in metabolism is the liver; its weight in

³ New York Medical Journal, November 10, 1917.

the infant to the body weight is as one to twenty, while in adults the ratio is only one to forty.

The infant requires daily 105 to 110 calories of food per kilogram of body weight and the adult requires only 35 calories per kilogram. An infant of ten weeks eliminates 1.6 grams of perspiration per kilogram of weight, while an adult eliminates one-half of the amount, 0.80 grams. A fifteen-pound child develops 90 B. T. U. per hour while a 150 pound man at light exercise develops about 40 B. T. U. per hour. The man is ten times heavier than the child but produces only four and one-half times as much heat. The infant breathes one and a half to two times as fast as the adult. These deductions from careful experiments demonstrate that the metabolic requirements of the infant are relatively much greater than those of the adult. The important part played by oxygen in metabolism consequently makes the need of fresh air imperative for the infant.

For respiratory purposes the adult needs 30 cubic feet of fresh air a minute. By old standards, it was thought that 600 to 1000 cubic feet of air space would suffice if the air was changed three times an hour, but modern hospitals for adults require 1800 to 2000 cubic feet, with more for infectious cases. Inquiry shows that in the judgment of modern pediatricists, children should have 1000 to 1500 cubic feet available, and these amounts, at least, are provided in most modern hospitals for infants.

When one considers the part played by ward infections in the morbidity and the mortality of infants, the present proximity of cribs permitted by law is to be condemned. It is agreed by pediatricists that not only is the spread of the common eruptive diseases favored by overcrowding, but, more important in infancy, the dangers from infections of the respiratory tract spread by coughing and sneezing—infectious colds, influenza, pneumonia, diphtheria, etc., are greatly enhanced by proximity. The minimum distance permitted by the present law is but two feet and no greater separation is usually possible when the allowance of air space is but 500 cubic feet. The pediatricists of the infants' wards in the hospitals of the University of Minnesota, after careful study concerning the prevention of cross-infection, have specified six feet as the desirable minimum for the separation of cribs. If every infant were allowed a minimum of 100 square feet of floor space there would be more than six feet of floor space between the cribs. Overcrowding invariably results in undercare, and pediatricists are unanimous in asserting that care is imperative if artificially-fed babies are to thrive. Mortality rises steadily in proportion as the number of cases in the ward are increased. Space, therefore, has more than one bearing upon infant mortality. It is a basic factor which underlies many other essentials for survival of the infant.

It is important to lay particular emphasis upon the fact that cubic space is not a perfect standard for respiratory needs. Ventilation is important and complementary. In a well-kept, properly managed and thoroughly ventilated modern institution less than 1000 to 1500 cubic feet for an infant might perhaps be allowed with safety. The elements that must be considered when scientific standards for ventilation are

formulated are as follows: Floor space allowed for each bed; height of rooms; window space; sunlight exposure; facilities for ventilation, as number and position of windows, doors, transoms and position of beds; method employed to secure ventilation; if artificial; character of the babies cared for, including age, conditions of health, whether bottle-fed; number of babies in a given ward and proportion of nurses or adults in the wards to the number of babies cared for; the infant mortality at the institution in question; and, last, the purity of the air.

The following are considered adequate standards of purity of the air: Temperature, 62° to 68° F.; humidity, 40 to 50 per cent.; wet-bulb thermometer should register below 70° F.; movements, gentle currents, three feet a second or two miles an hour—air moving more rapidly than three feet a second is felt as a draft; carbondioxide contents should not exceed six parts in 10,000 by the lime-water test; freedom from dust, microorganisms, gases and odors—air should not contain more than fifty microorganisms a cubic foot (expose nutrient medium in Petri dishes and count colonies of growth); normal clinical effects on mucous membranes and upon blood-pressure; quantity not less than thirty feet a minute a child.

In summing up the whole subject the committee recommends: (1) The present law relating to ventilation in institutions for children, which is utterly inadequate, should be abrogated and superseded by legislation, which should be based on definite and scientifically grounded standards. (2) The air space allowed should be from 1000 to 1500 cubic feet for a child, especially for sick babies. Artificially-fed babies, owing to the frequency of digestive disturbances, their susceptibility to illness and their high mortality, should be rated as sick babies. There is no essential difference between institution wards and hospital wards when infants are artificially fed. The longer stay in the institution than in the hospital increases the susceptibility to illness and malnutrition and at least equalizes the requirements for space. Newborn infants might be allowed less space for the first two weeks of life if nursed at the breast. (3) When rooms are very high the cubic space for a child should be made liberal to prevent proximity of beds; each bed should have 100 square feet of floor space. (4) In order to minimize the danger from cross-infection, beds and cribs should be separated from each other by a distance considerably greater than the two feet required by the present law; six feet would make a desirable distance between beds. (5) All rooms, particularly those in which artificially-fed infants are kept, should be provided with proper devices for window ventilation at all seasons. (6) The State Department of Health should possess the exclusive power of control and regulation and no local board or department of health should have the power to alter the standards specified in the law. Exceptional permits to deviate from normal standards may only be granted by the State Commissioner of Health upon the recommendation of an accredited inspector, accompanied by a written report showing adequate grounds for such recommendation. (7) Frequent inspection should be required at irregular intervals.

Diabetes Insipidus in Children. While this is not essentially a disease of childhood, it is of sufficient frequency to warrant the report of a careful study made in the case of a boy, aged nine and a half years, reported by Clausen, of St. Louis. It often happens that observations made in the earlier periods of life throw unusual light upon diseases which are usually regarded as belonging to later life. The observations of Clausen⁴ show a striking relief of symptoms following the injection of extracts of the posterior lobe and pars intermedia of the hypophysis cerebri. The following may be given as a brief summary of the results obtained under this treatment: Following injections from 0.25 to 1 c.c. of surgical pituitrin there is a marked diminution of urine volume. This diminution persists from five to six hours, sometimes much longer. The volume of night urine is reduced when pituitrin is injected at any time on the preceding day. The hourly rate of elimination of chlorides is always reduced after injections of pituitary solution. The hourly rate of the elimination of urea is only slightly, if at all, reduced, by injection of pituitary solution. The hourly rates of elimination of creatinin and uric acid are only slightly reduced by injection of pituitary solution. The hourly rate of elimination of titratable acids in the urine is only slightly influenced by these injections. The hourly rate of elimination of no substance studied is increased by injections of pituitary solution. When the hourly ingestion of sodium chloride or urea is maintained at a constant high level, the urea elimination is quite uninfluenced by the injection of pituitary solution, whereas the chloride elimination is considerably diminished and the water elimination is very much diminished. Pituitrin injections in diabetes insipidus control urine output primarily and thirst secondarily.

Enuresis. Enuresis is one of the most trying conditions that come within the domain of the general practitioner. In many cases, local conditions will be found upon careful examination, and it need hardly be said that a thorough examination should be made in every case. Almost every year in reviewing literature, I find that some enthusiastic practitioner has affected a cure by circumcision. There are two answers to be made to this proposition. The first is that there is a large psychological element in every case, and a severe and radical operation produces a psychological result. But it is important to remember that little girls are more subject to the condition than little boys. Hence, if we pin our faith to circumcision we shall be able to reach but a small proportion of our little patients suffering from this unfortunate malady.

An unsigned article⁵ presents some features of this condition in a most judicious manner. It points out the fact that bed-wetting is a trying enough condition in the case of the individual child in the home, but in an institution caring for a great many it becomes a serious problem when present in a large proportion of the children. Formerly, whether occurring in the home or the institution, the condition called for disciplinary measures, on the assumption that the child was wholly responsible. At present, however, it is the consensus of

⁴ American Journal of Diseases of Children, September, 1918.

⁵ Medical Record, August 3, 1918.

opinion that enuresis is entirely a medical problem, not within the individual will of the child to prevent, nor influenced by punitive measures.

Even when no definite pathological condition is found to account for the local manifestation, it is apparent that enuresis often accompanies an inferior mental or physical constitution. It is, perhaps, very common in the precocious but nervous child in whom the degree of mental precocity would seem to rule out wilful bed-wetting. However, the irritability of the nervous system in children of this type causes an undue reaction to any stimulus, and they have little control over any of their functions. Of course, there are tangible local conditions that cause incontinence in the bladder, but these do not constitute the problem of bed-wetting. On the other hand, as a purely local condition, but which must cause the great majority of cases of enuresis, anomalies of the foreskin of male children and adhesion of the rudimentary one in female children hold the first place. When this is recognized as the etiological factor, circumcision seems to cure about 80 per cent. of these cases. There is now no longer any doubt that circumcision in a male child is a prophylactic measure of importance, not only in preventing this condition but in the prevention of many bad habits. As a therapeutic measure in many backward children who display no basis for mental deficiency, it may be compared with operations for the relief of obstructions to respiration.

But although these physical and nervous conditions are the basis for bed-wetting, there are many exciting causes that need attention in order to prevent the attack or as after-care in cases having received the active treatment indicated. Any circumstance which encourages relaxation of the sphincters during sleep encourages bed-wetting. Sleeping in an overheated room, in an overwarm bed or on or under a feather bed is likely to cause bed-wetting in a child so inclined. Also, a child of this type sleeping with an overfilled bladder will soon lose the power of resistance of the compressor muscle, especially since he already has poor power of control over it. It is for this reason that fluids of any kind must be interdicted to such a child after about six o'clock. And it goes without saying that awaking the child during the night to empty its bladder will prevent the annoyance of the bed-wetting until such time as the appropriate therapeutics makes this unnecessary. Drugs usually given in this condition seem of doubtful value, except such as are tonics to the entire organism. Unless the medical point of view is accepted in relation to the cause of enuresis, and treatment is instituted accordingly, little improvement can be expected. On the contrary, the punitive measures usually adopted can but aggravate the condition.

Differential Diagnosis of Enlargement of the Cervical Lymph Nodes. Enlargement of the cervical lymph nodes is one of the most common affections of childhood. It is usually secondary, and it is, therefore, of particular importance that the primary condition should be discovered. An admirable review of the subject is presented by R. S. Haynes.⁶ Enlargement of the cervical lymph nodes may be regarded in general

⁶ Archives of Pediatrics, April, 1918.

as falling into three classes: (1) Inflammations, simple or tuberculous; (2) hyperplasias; (3) neoplasms. These pathological processes do not adhere with consistency to particular disease entities but both hyperplasia and inflammatory swelling may result from infection and a neoplasm may become the seat of active inflammation.

As types of neoplasms, the least common are lymphadenoma as primary diseases, and carcinoma as a secondary process. Hyperplasias of the lymph nodes occur typically with infectious diseases, particularly the exanthemata, scarlet fever, German measles, measles and diphtheria; with syphilis, and, more rarely, generalized tuberculosis; leukemia, Hodgkin's disease and the glandular fever of Pfeiffer.

The commonest forms of enlargement of the cervical lymph nodes are the infections, enlargements secondary to bacterial invasions of structures of the head and throat, whose lymphatic drainage terminates in one or other of the group of lymph nodes situated in the deep and in the superficial structures of the neck.

In the differential diagnosis of these various enlargements, the questions requiring elucidation in chief are: What is the character of the malady? Is it a new growth, the hyperplasia due to German measles or syphilis, or to inflammatory enlargement due to an eczema behind the ear?

If it is due to an infection, what is the location of the primary source of the infection? Is it on the scalp, on the gums or in the nasopharynx? If it is an infection, what type of infection is it? Is it a simple pyogenic affair, or tubercular? We shall have as aids in arriving at our conclusions: The history of the patient, his age, his personal and social hygiene, his contacts, the characteristics of his food, the presence or absence of illness of any kind, the duration of the enlargement under consideration, its rapidity of growth, its progress from one group of lymph nodes to other groups. The location of the affected nodes. The condition of the tissues to which the nodes affected are known to correspond. The size, shape, color, consistence, heat of the enlargement, its relation to the skin and to the surrounding and deeper tissues, the discreteness or conglomeration of the constituent lymph nodes. The condition of lymphatic tissues in other parts of the body. General signs of disease elsewhere. Results of examination of the blood—its cytology, hemoglobin, and bacteriology. The results of serum reactions, the Wassermann and the tuberculous complement-fixation tests. The results of skin reactions, the von Pirquet and other tuberculin tests, the luetin test, and, conceivably, the Schick reaction. Roentgen-ray examination of the head and neck disclosing tooth abscesses or calcareous nodes; or of the thorax, disclosing widespread tuberculosis. The examination of removed tissues in the lymphatic area of the affected nodes, such as adenoids or tonsils. The examination of pus aspirated from the enlargement mass, and, lastly, the examination, macroscopic, microscopic and cultural, of the enlarged lymph nodes themselves removed at operation.

Enlargement of the cervical lymph nodes other than those due to infections are usually accompanied by signs of disease elsewhere, which serve to establish a diagnosis even if the enlargement *per se* cannot be

differentiated. The glandular enlargement accompanying the exanthemata are essentially acute, and are accompanied by the symptoms and physical signs of the primary disease.

The enlargement of the cervical nodes which occur in syphilis is part of a general adenopathy affecting the liver, spleen, inguinal and epitrochlear nodes. The blood examination may show nothing characteristic in its cytology, but the Wassermann reaction and the luetin skin reaction should be positive. The splenic and epitrochlear enlargements are important confirmatory evidence. The nodes will be discrete, without signs of inflammation and not adherent to adjacent structures, nor will there be any tendency to suppuration. No focus of infection will be apparent. Such nodes, if excised, may show the *Spirochete pallida*.

Hodgkin's disease may present a picture which may be confusing because, in Hodgkin's disease, the cervical nodes may be the first to be involved and because it is often accompanied by fever. Here, however, the constant progression of enlargement without coalescing and without suppuration, the involvement of other groups of nodes, particularly within the thorax and abdomen, where lymph nodes secondary to infected cervical nodes are not to be expected, the splenic enlargement, the progressive anemia and the finding of characteristic Hodgkin's hyperplasia on section of a removed gland would serve to establish the positive diagnosis.

Lymphosarcoma may appear like Hodgkin's disease at first and have a similar differentiation, but there is a tendency for the capsule of the nodes to rupture, the nodes to become adherent to each other and the surrounding tissues. The course is rapid and the swelling very large. Carcinoma is very rare in childhood.

Acute lymphatic leukemia is the only form of leukemia in which a cervical enlargement may need differentiating. In its early stages it presents enlargement of nodes up to walnut size, discrete, with little or no redness or tenderness. Later, when hemorrhagic changes take place in the mouth and throat, infection is often superimposed upon the picture. The diagnosis will be made by the examination of the blood: Anemia with 1,000,000 to 3,000,000 red blood cells. Hemoglobin of 20 to 30 per cent., leukocytes of 50,000 to 150,000, of which 90 to 98 per cent. are lymphocytes, mostly of the large variety, are the expected findings.

Infection of the posterior part of the scalp will cause enlargement of the occipital group of glands; of the ear, mastoid or scalp about the ear, in the pre- or post-auricular nodes; of the face about the ale of the nose, in the pre-auricular or parotid glands; of the nose, upper lip, lower lip, side of tongue, in the facial or submaxillary group; of the lower lip and chin, in the submental group. Infection of the gums and periosteum may cause enlargement of either the submaxillary group or the superior lymph node of the anterior group of the deep chin. Infection of the nose or nasopharynx will cause enlargement first, of the retropharyngeal lymph nodes and then of the posterior group of the deep set lying under the posterior border of the sternomastoid or of the latter in the first

instance. Infection of the tonsil will cause enlargement first of one particular node called by George B. Wood the tonsillar node. This node is larger than its fellows and very constantly is found at the juncture of the anterior border of the sternomastoid with the posterior belly of the digastric muscle. It receives directly the lymphatic drainage from the tonsil and may be considered to have established a good title to its name.

Pernicious Anemia in Young Infants. Two cases of pernicious anemia in infants of eleven and five months are reported by d'Espine.⁷ He has previously published 2 personal cases and compiled a list of 56 cases from the literature. This latter group includes 32 cases in which the anemia was traceable to the bothriocephalus or a tenia. Only 2 cases are known of essential progressive pernicious anemia in older children. A girl of six died in six weeks after the first symptom of the hemorrhagic pernicious anemia, and a boy presented a simple anemia for several years which assumed the pernicious type at the age of thirteen, and he died two years later. There is no verified case on record of pernicious anemia in young infants, and, in the 2 cases reported, the infants recovered. In the first case a one-sided diet was incriminated, the pernicious anemia being regarded as, to some extent, an equivalent for scurvy. The other child was breast-fed. The clinical picture was that of true pernicious anemia in each case, except that there was no leukopenia. The recoveries are ascribed to the special serotherapy used. The serum was obtained by venesection of animals at the height of the regeneration of blood following a previous extensive withdrawal of blood. This "hematopoietic serum" seems to have a decidedly favorable action on the composition of the blood when injected in cases of pernicious anemia. These infants were given daily subcutaneous injections of 5 to 10 c.c. of the serum. The changes in the blood count, from hemoglobin 20 per cent. and reds 658,875, to 53 per cent. and 2,102,125 reds in nine months, testify to the efficiency of this form of serotherapy. In the first case the hemoglobin rose from 25 to 75 per cent. in a month.

ROENTGEN EXAMINATIONS OF THE CHEST IN CHILDREN OF DIFFERENT AGES. Twelve girls and eighteen boys, all being the children of working men, were examined by Sgobbo.⁸ Of all these, both those apparently healthy and those showing symptoms of disease, only 20 per cent. gave normal findings in the lymphatic glands of the mediastinum and lung. In those with pathological antecedents of any sort, positive findings were invariably found. Other than tuberculous processes may in some instances have caused some of the glandular lesions.

Intestinal Atony in Children. The fact that a disease frequently appears in children in a form radically different from the course pursued in adults is referred to by Turck,⁹ of New York. In his work upon gastro-intestinal diseases, he reports extensive observations upon young children. While the mechanism of intestinal atony in children is initiated by the

⁷ Revue Médicale de la Suisse Romande, Geneva. Journal of American Medical Association, October 26, 1918.

⁸ *Pediatrics*, Naples, July, 1918.

⁹ New York State Journal of Medicine, January, 1918.

same causes and follows a similar course of events in the establishment of a vicious circle, there are certain predisposing factors which make the child more susceptible than the adult to gastro-intestinal disturbances. The etiology of intestinal atony in children must be viewed, as we are coming more and more to view all the problems of medicine, from the standpoint of the dynamics of life. We must recognize the role of the physics of colloids in biology, which has created a new concept of normal and abnormal function. We must remember that the lumen of the intestine acts as a membrane filter for colloids and at the same time is itself colloid in character. It determines the rate of the colloid suspensions that filter through it. For instance, a transparent colloid, such as a boiled starch mixture forming a jelly-like fluid containing finely diffused particles, may pass easily through a filter as though it were a solution. The fluids of the body that diffuse through the tissues have much the same properties.

With this conception as the basis of our investigation, we find that in the production of intestinal atony there are a number of factors involved as: (1) Increased permeability of the intestinal tract; (2) agencies which are responsible for this increased permeability; (3) a previous sensitization of the mucus cells, rendering them susceptible to anaphylactic reaction; (4) fatigue; (5) tension. Other pathological states also exert an influence.

In a series of experiments including 155 animals, cats, monkeys, rats, rabbits and guinea-pigs, Turck found that all gave the same picture of the migration of the bacteria from the intestine into the submucous tissue (*zona transformans*). Furthermore, he has been able to show, by staining methods, the rate of diffusion and the route by which diffusion occurs. The route taken was always between the glands and cells and never through them, neither do the bacteria enter the blood-vessels or lymphatics, but they pass by way of the muscular mucosa. It was found that cultures of *Bacillus coli* injected at different sites took different routes of diffusion, some going to the liver, some to the kidneys, some to the pyloric region, according to the site of the injection. The general direction, however, was cephalad.

The histological changes at the site of the retardation or arrest of the bacteria are shown by the fact that the nuclei of the cells of the parenchyma lose their staining properties to both Gram and hematoxylin stains. It may be stated, in a general way, that any pathological condition that lowers the vitality and resistance of the child favors bacterial invasion. The exanthema, meat extractives and fatty acids lower the tone of the intestinal musculature and provide conditions for a rapid and overwhelming bacterial invasion. In this connection experiments in feeding meat extractives and fatty acids are both interesting and convincing.

What actually occurs is that if we have a child born hypersensitive, in order that dilatation be produced we must have tension upon the muscles, as the result of overfeeding, water gas, etc. Tension occurs in the areas used as reservoirs, and it must not only be temporary but it must be prolonged in order to produce splanchnic congestion and atony.

In such a state of tension, muscles are more easily fatigued than under normal conditions, and fatigue, as we have shown, results in asphyxia of the muscle cells.

The treatment of gastro-intestinal disorders in children, as in adults, must be guided by what we have learned of the etiology of these conditions, and hence must be physiological, pathological, symptomatological and bacteriological; it must also be governed by the severity of the case and whether it is acute or chronic in character. In the treatment of severe acute cases, where there is evidence of stasis and death is impending, the first indication is for heat stimulation, such as hot sitz bath, as hot as can well be borne, and, in addition, gastric and colonic lavage with bicarbonate solution given at a temperature of 110° to 118° F. The high temperature provides the requisite stimulation, serving to bring the blood to the surface of the body, thus producing hyperemia and activating the antibodies. The colonic lavage given at a high temperature may be followed to advantage with cold stimulation. It may be an advantage in very severe cases to give the lavage continuously. Here the use of the double recurrent tube is to be preferred.

In these acute cases starvation is, of course, to be enforced and milk avoided by all means. One may administer subcutaneous injections of salt solution or of sugar in solution, just sufficient to create stimulation but not sufficient to burden the heart. Transfusions of blood are indicated in certain cases, just as they are now given in cases of anemia and hemorrhage; citrated blood is to be preferred. Such transfusions are not only helpful in overcoming the splanchnic condition, but also assist in the formation of antibodies. Subcutaneous injections of blood or autogenous serum may also be resorted to. After the acute stage is passed, feeding may gradually be resumed. Cornstarch gruel is highly satisfactory, but it is important to remember that all fats must be avoided.

In the treatment of the moderately severe or chronic cases, gastric and colonic lavage should hold an important place, and should be given in connection with gentle pneumatic gymnastics of the colon. The feeding, in these cases, must meet the requirements of the individual case and be governed by the age of the child. Certain general principles, however, must be regarded, among which it is important to lengthen the period between feedings as much as possible, since such a course is indicated by the needs of the gastric and intestinal musculature for rest. Meat extractives should likewise be eschewed for the reasons brought out in connection with our experimental work. In older children, extract-free meat may be allowed in moderation.

To prepare extract-free meat, the meat is chopped in a meat grinder and the juice pressed out. It is then left in cold water over night. In the morning the juice is thrown away, and the chopped meat placed in a steamer for two or three hours. The juice is again discarded. The pulp remaining represents the portion of the meat that may be taken without danger of getting the toxic portion. The vegetables fed to these children should be hydrolyzed, and such vegetables chosen as are rich in mineral salts. The extract-free meat should likewise be fat-free; on recovery,

the child should be given neutral fats in the form of fresh butter, olive, or cotton-seed, oil.

These chronic cases are the ones which offer an appropriate field for the employment of autogenous vaccines. In many children there are two or more organisms present and there may be similar organisms present in the feces, the urine and the stomach. We frequently find the colon bacillus present in connection with the streptococcus or staphylococcus. A careful examination will show these bacteria present in far greater numbers than in normal conditions.

Pyloric Spasm and Congenital Pyloric Stenosis. This subject has been considered in these pages for several years, but still continues to create decided interest in the profession. Few other subjects, in fact, have received more attention. A very interesting historical article has been written by John Foote,¹⁰ of Washington, who records probably the first reported case of this condition. Those old doctors of one hundred years ago or more were extremely acute in their observations, and the report is one of great interest and leaves the modern clinical observer much room for thought. In 1788 Hezekiah Beardsley, an American physician, published a report of a "Case of Scirrhus in the Pylorus of an Infant," which Osler, in 1903, identified as "congenital hypertrophic stenosis of the pylorus."

While Beardsley's monogram still stands as the first separate publication dealing with pyloric spasm and stenosis, the distinction of describing and actually naming the symptoms and pathology of this disease of the newborn with the term we now use apparently belongs to George Armstrong, an English pediatricist, whose work appeared in 1777, as a text-book entitled *An Account of the Diseases Most Incident to Children from Their Birth to the Age of Puberty, with a Successful Method of Treating Them*, etc. (London, 1777). This text-book was accorded several reprintings, and was rewritten by Buchan in 1808. Clinical and post-mortem findings, a typical case history and a family history, including three similar cases, led Armstrong to conclude that a child which he had treated for "watery gripes" died from "*spasm of the pylorus*." In discussing the reasons why antimonial emetics sometimes fail to produce beneficial results, Armstrong has described a macerated or softened condition of the intestines seen in some fatal cases. He says: "In a child about three weeks old that died of the watery gripes, and which I opened some time since, I found most of the stomach toward the upper orifice and almost of the whole fundus in the same tender state. But toward the pylorus the structure was firm enough, as likewise that of the intestines, both small and great. The stomach was quite distended with curdled milk and victuals, with which the nurse had crammed the child, mixed likewise with some of the chalk julep, but the whole intestines were remarkable empty. There were no morbid appearances to be observed anywhere but in the stomach, and this viscus being so full while the intestines were almost empty, it looked as if the disease had been chiefly owing to a spasm of the pylorus, which

¹⁰ American Journal of Diseases of Children, May, 1918.

prevented the contents of the stomach from passing into the duodenum." As to his term "the watery gripes," we find on page 20 "that vomiting and green stools are the threatening symptoms, which if allowed to continue often end in convulsions and death." The stomach is a soft and flabby texture in contrast with the firm pylorus, and containing food, "while the whole intestines were remarkably empty," leads him logically to his conclusion that "it looked as if the disease had been largely due to a *spasm in the pylorus*." He, however, omitted any comment on the intimate structure of the pylorus itself, being probably content with a physiological, rather than an anatomical, explanation.

It may not be out of place to add that George Armstrong organized the first and only hospital and dispensary for poor children in London in his day, in the year 1769. It was here he made his therapeutic experiments and had opportunity to compare clinical records with the post-mortem findings scattered so plentifully through his text-book. Here, too, he formulated his excellent "Rules for Nursing."

A study of 101 cases of pyloric stenosis is reported by Alfred Strauss,¹¹ of Chicago. The same number contains a carefully written article by Haggard,¹² of Nashville, who considers especially the symptoms and treatment. In the order of their importance the symptoms are as follows: (1) Persistent, recurrent, explosive vomiting; (2) starvation stools and diminished urine, with emaciation; (3) visible gastric peristalsis; (4) palpable tumor; (5) bulging epigastrium, with stretched abdomen; (6) progressive loss of weight. The symptoms may appear within a few days after birth, or be delayed until the second, or rarely the third, month. They usually appear during the third or fourth week. Vomiting is usually the first symptom noted.

As to the treatment, the rule should be that only the very mild cases without contractions of the tumor should have medical and dietetic treatment. If the infant is not losing weight and the vomiting is mostly regurgitant and not projectile, and there is at least one milk stool every forty-eight hours, and if the roentgen ray shows an appreciable amount of food passing through the pylorus, tentative medical treatment may be employed. All others should be treated by operation, just as any other mechanical obstruction in the alimentary canal. If no really material gain has been brought about in one or two weeks, or if the baby is losing, operative treatment is urgently indicated before the child gets into a wellnigh hopeless condition. Even if the child should eventually recover, it will be only after a very prolonged and perilous course.

It has been shown by Holt and Downs, at the Babies' Hospital, New York, that during a period of fifteen years, when the operation was performed only after the patient had resisted medical treatment, the operative mortality was 58 per cent. When the diagnosis was made and operation resorted to soon after admission and diagnosis, the surgical mortality dropped to 43 per cent. Abt thinks that less than one-third of the patients recovered under medical treatment. If every patient were operated on with the present improved technic as soon as the

¹¹ Journal of the American Medical Association, September 7, 1918.

¹² Ibid.

diagnosis is established, the mortality might be reduced to about 10 per cent. Failure to seek prompt surgical relief is too often fatal. Even though the baby may be apparently holding its own under medical treatment, it may suddenly, and without apparent cause, become progressively worse and die in a short time.

Local anesthesia is much more satisfactory in an infant than in an adult. An infant has little or no physical consciousness of pain and no fear. Local anesthesia really blocks off all traumatic stimuli to the brain, to say nothing of the absence of the shock and dangers of an inhalation anesthesia. General anesthesia is no more satisfactory to the operator and may be extremely harmful to the child. It is certainly not as safe nor as necessary to give narcosis for the operation of pyloroplasty.

Kerley,¹³ of New York, reports 26 cases of pyloric stenosis which came to operation, the operator in most instances being Downes. Seventeen of these patients were boys, 9 were girls, the ages at the time of operation being from three to sixteen weeks. The lowest weight at operation was 4 pounds 2 ounces; the birth weight was 5 pounds 8 ounces. This patient made an uneventful recovery. In 17 cases, 9 vomited post-operatively, but all of these recovered. Postoperative temperature above 101° was noted in 7, in one 104° and in one 103°. Four cases ended fatally, a mortality of 15.3 per cent. In 3 of these the children had vomited for weeks and were in wretched condition; the fourth case had vomited for ten weeks, but in spite of this was in fairly good condition. The postoperative treatment carried on at the Babies' Hospital is that evolved by Holt. It consists in wrapping the child in a warm blanket when it comes out of the operating room, and, when in bed, surrounding it with hot-water bottles outside of the blanket. For an hour or two after coming out of the operating room the head is kept lowered to prevent the aspiration of mucus into the larynx. This is absolutely necessary. Ten or twelve hours later the patient is placed in the semi-erect position to prevent the regurgitation of food and permits the more easy escape of gas. As soon as the patient is placed in bed, hypodermoclysis of 120 c.c. of normal saline is given, and, if the condition is poor, a hypodermic of adrenalin (1 to 1000) is administered and repeated in four or five hours. Dilute whisky every few hours for the first five or six days has proved of great value. Transfusion in a few cases which have collapsed has been of material benefit. One and one-half hours after operating 10 c.c. of barley water and 4 c.c. of breast milk is given. Two hours later 8 c.c. of breast milk and 4 c.c. of barley water is administered. Breast milk is then given every three hours and alternated with water and gradually increased in amount, so that in forty-eight hours about 30 c.c. is given at a feeding with 4 c.c. of barley water. The barley water is then discontinued and on each successive day the amount of milk is increased 5 c.c. at a feeding, so that by the eighth day following the operation the baby is taking 60 c.c. of milk at each feeding. On the third day the intervals of feeding at night are lengthened to four hours, so that seven feedings are given instead of eight. By the eleventh or twelfth day the baby is nursing entirely.

¹³ Archives of Pediatrics, June, 1918.

In well-nourished infants a sponge bath is given daily; in emaciated children an oil rub is preferable. Measurement of the food must be kept up one week longer by weighing the baby before and after nursing. In cases of vomiting due to the accumulation of gas in the stomach the child should be raised to an upright position after feeding. If this does not suffice a soft-rubber catheter may be passed into the stomach before each feeding. If vomiting still persists, gastric lavage may be employed. One teaspoonful of castor oil is usually given twenty-four hours after operation if there have been no stools. If there are more than three or four stools a day, protein milk should be submitted for three or four breast-feedings. The wound is not disturbed for four or five days unless some indication arises. The stitches are removed on the ninth or tenth day. A low mortality in these cases depends upon early diagnosis and immediate operation.

The Well Babies' Clinic. The plan adopted for the well babies' clinic in San Francisco is described by Yerington.¹⁴ It is held every Friday morning in separate rooms fitted up for this purpose, with a reception room, weighing and examining room, and a large outer room with three desks for the clinicians. The histories are brought from the central history room, the baby is undressed and weighed and the weight reported by a volunteer worker. The social service worker supervises this work, discussing home conditions and needs of the parent, and the histories of the babies are then brought into the outer room to be observed by the physician.

The babies are brought for examination every week for the first three months and every two weeks from the third to the sixth month, every month from six months to one year. They are transferred then to the children's clinic. Every mother delivered either in the maternity ward in the hospital or in the out-patient obstetric service is given a card asking her to report with the child to the baby clinic when it is three weeks old. From May, 1917, to May, 1918, there were 2146 visits to this clinic, 348 being new cases. Of 290 deliveries in the hospital, 194, or 67.8 per cent., returned to the baby clinic. Of 126 deliveries on the outside service, 53, or 42 per cent., returned. This shows a close bond between the hospital and the baby clinic.

In order to stimulate the work and keep a check on such a clinic the social service worker plays the leading role. A card system is kept, postal cards are sent to those not attending the clinic, and, if there are no responses, the cases are followed up in the homes. At the present time more than 200 calls a month are made by the social-service workers connected with the clinic. In the organization of a work of this kind, intimate knowledge of the home surroundings of the infant is of great importance and the sympathetic relationship between the social-service nurse and the mother is imperative.

Status Lymphaticus. After careful study of this much-discussed subject, Simmers,¹⁵ of New York, concludes that sudden death in status lymphaticus may be brought about in two different ways: The first and most frequent

¹⁴ Journal of American Medical Association, September 18, 1918.

¹⁵ American Journal of Diseases of Children, December, 1917.

cause is in the nature of an anaphylactic reaction due to sensitization of the body by a specific nucleoprotein formed in the lymph nodes as the result of necrosis of numerous germinal follicles. Before the so-called anaphylactic incubation period has expired, the tissues are again subjected to the action of the same protein formed in the same type of tissue in response to apparently trivial injury, and, in this way, the anaphylactic reaction is completed. A second cause of sudden death in status lymphaticus is to be found in the form of spontaneous rupture of hypoplastic cerebral vessel or rupture following apparently trivial injury, the deficiency in the vessel wall being most noticeable in the muscular coat.

Renal Colic. Renal colic and kidney and urinary stones are rare in children. Cases of all these varieties are occasionally reported, however. A true case of kidney colic is reported¹⁶ in a boy, aged six years, who had suffered from attacks for three years. They were finally explained by roentgen discovery of two concretions in the pelvis of the left kidney. There never had been any hematuria, pyuria or albuminuria, and the general health was excellent throughout.

Thirty-five cases of urinary stones in children have been compiled by Peuch and Souza¹⁷ in ten years. They were nearly all in the families of immigrants. Only 3 per cent. were found in girls. All the patients were over one year in age and the majority were between three and five. Phimosi appeared in 70 per cent. of the cases. Suprapubic incision is the best treatment.

Ballantidium Coli. A case of this character is reported by De Buys,¹⁸ of New Orleans. The disease is a rare one in man, less than 150 cases having been reported, and very rare in childhood, there being but 3 instances. The age of the patient whose case was reported was five years, next to the youngest case of *Ballantidium coli* infection on record. The patient was a boy who helped in rounding up pigs and ate his food at times in the pig-pen. He gave a history of having been ill for nearly a year with diarrhea. There were periods of improvement, with recurrent attacks, each attack more pronounced than the preceding one. The stools resembled those of amebic dysentery, containing blood and mucus. The rectal tube was passed and the organism identified. The patient was poorly nourished and the skin dry. There was a catarrhal stomatitis, otherwise the physical examination was negative, with the exception of some pain over the lower abdomen. De Buys advises the use of emetine, since, because of the resemblance of the infection to that of amebic dysentery in the invasion and location of the organism in the tissues, in the histological pathology and in its clinical manifestations, it is hardly to be expected that local flushings would be of any avail after the infection is established.

Hirschsprung's Disease. A case of this unusual condition is reported by Carr,¹⁹ of New York. He states that his patient was six years of age, of Italian parentage, and was brought to the City Hospital in an

¹⁶ Archives Latino-Americanos de Pediatria, March-April, 1918.

¹⁷ Annes Faunstas de Medicina e Cirugia, S. Paulo, April, 1918, ix, No. 4.

¹⁸ New York Medical Journal, October 5, 1918.

¹⁹ Ibid.

ambulance without a history except that she had been constipated for five years and had vomited for twenty-four hours. She was in a condition of shock. The temperature was 97.5°; pulse, 120; the thirst was intense. The abdomen was greatly distended and there was constant involuntary discharge of feces. Colonic irrigations of normal saline solution were given, with stimulation, heat, etc. The child died eleven hours after admission. A partial necropsy showed a marked distention of the intestines, particularly evident in the sigmoid colon, which was bent upon itself. The wall of the upper part of the rectum and lower part of the colon slightly calcified and the lining mucous membrane was very granular. There was hyperplasia of the mesenteric lymph nodes. The anatomical diagnosis was idiopathic dilatation of the sigmoid colon, Hirschsprung's disease, with secondary calcification of the upper part of the rectum and the lower part of the sigmoid. A microscopic examination of the tissue from this specimen showed a complete loss of mucous membrane, and in its place a vascularized round-cell proliferation of the submucosa. There was a corresponding hypertrophy of the inner and outer muscular coats.

Cribbing, with Dilated Stomach and Dilated Diaphragm. Cases of this kind, with varying degrees of severity, are not uncommon. A severe case is reported by Eaton,²⁰ of Pittsburgh. The patient was a baby, three weeks old, who had lost more than a pound since birth. It sucked its fists, tongue and a nipple, and always vomited a great deal. The stomach was dilated, the outline being easily made out. The wave motion was quite visible and somewhat exaggerated. There was much tympany of the stomach and little of the intestine. By attention to posture, prevention of unnatural sucking, massage, properly modified food and absolute regularity of feeding the trouble was corrected. An occasional dose of strontium bromide was given and the child also had phosphorated oil in cod-liver oil and an abundance of fresh air and sunlight constantly. The remarkable thing was that the child's sister, now three years of age, was also a cribber. Herman,²¹ of New York, recommends the use of atropine in cases of this kind.

Vegetable Milk. A preliminary study upon a milk prepared from almonds is reported by Chapin and Kast,²² of New York. They believe it has certain advantages from both theoretical and practical standpoints. Its theoretical advantages are: (1) It ferments much less rapidly than ordinary cows' milk; (2) it has a higher fat ration in the form of almond oil, which is sufficiently emulsified to render it easily digestible; (3) the proteins contained in this milk are much less liable to undergo putrefaction than the casein of cows' milk; (4) almond milk contains a large amount of phosphorus and a small quantity of sodium chloride, which would suggest its favorable employment in such conditions as rickets and nephritis. From its low carbohydrate content it can be readily seen that it would be useful in various forms of sugar fermentations.

On the practical side it has been tried on more than 1000 adults by

²⁰ New York Medical Journal, October 5, 1918.

²¹ Ibid.

²² Ibid.

Kast, and, while some disliked it, actual disturbances were not caused by it. No patient has shown an idiosyncrasy to it. Patients kept on almond milk alone maintained their equilibrium of metabolism, and usually gained in weight. It was particularly well taken in the following conditions, and served a good purpose: nephritis, typhoid fever, intestinal putrefaction, malnutrition and secondary anemia. This preparation is rich in vitamins. While they do not recommend its permanent use, they consider it desirable as a temporary substitute.

Milk. DRIED MILK IN INFANT FEEDING. The use of plain dried milk as an infant food has been extensively studied by Dennett,²³ of New York. He used it in a variety of cases and concluded it is very satisfactory and has a number of advantages over other forms of feeding. Dried milk, in his experience, is better tolerated than raw or boiled milk mixtures by infants who have previously suffered a food injury, indicating that it is better and more readily digested. It is also of great value for the infant who does not prosper on the various milk mixtures, and should be given in such instances without delay. Its use often controls vomiting within twenty-four hours and intestinal indigestion is overcome immediately. If given along with orange juice after the first week or two, its prolonged use does not produce either rickets or scurvy. It is simple to prepare, being merely mixed in the prescribed proportions with hot water. To supply fifty calories daily per pound of body weight, three tablespoonfuls of dried milk, leveled with a knife, must be given for each pound of body weight. This is too high a food value for any but very poorly nourished infants, and most babies will gain adequately on forty calories per pound per day.

The maximum concentration of dried milk mixture should not exceed one tablespoonful of milk per ounce of water. When beginning the use of dried milk in any case in which there has been food injury, much less should be prescribed than is called for by the body weight, and the amount should then be raised rapidly as tolerance is established, just as in any other change in diet in infants. The ready digestibility of dried milk may possibly depend upon the fact that the casein in it does not clot in the stomach in large masses, but the small grains merely swell, and are, therefore, very easily attacked both by the gastric and intestinal secretions. The milk also has a low fat content when diluted with the proper amount of water and contains a larger proportion of the fatty acids than whole milk. These tend to form soaps very easily, and these soaps in turn favor the emulsification of the fat and enhance its digestion.

The relatively high protein content of dried milk makes desirable the addition to it of sugars or gruels, or both, after the digestive disturbance has been controlled, and this addition also avoids the possibility of the urine becoming excessively ammoniacal when large amounts of the milk are being taken. Other advantages of dried milk are its convenient form, its sterility and the fact that it will keep for long periods of time even after the container has been opened.

²³ New York State Journal of Medicine, July, 1918.

MARKET MILK. Bacteriological examinations of market milk at Buenos Aires²⁴ demonstrated that over 11 per cent. of the specimens of market milk were contaminated with tubercle bacilli and that pasteurization effectually killed them. None of the 56 guinea-pigs in one series or of 52 in another series developed tuberculosis after being inoculated with milk pasteurized at 85° C.

THE BABY THAT CANNOT TAKE MILK. One of the most informing articles upon this subject is that of T. Wood Clarke,²⁵ of Utica. It cannot, however, be well abstracted, as it contains tabulated case reports, charts and tables. His general conclusion is that excluding infants with some constitutional malady, as a result of which no food is of value, provided one has a clean pure milk available and one uses patience, intelligence and courage in ordering the administration thereof, practically every baby can be made to take and digest cows' milk. The baby that actually cannot take cows' milk at all is rare enough to be worthy a place in a medical museum.

THE VITAMINES OF MILK. Some ten years ago F. G. Hopkins, the English physiological chemist, found experimentally that an animal cannot live on a mixture of pure protein, fat and carbohydrate; and even when the necessary inorganic material is carefully supplied, the animal still cannot flourish. In connection with these investigations he made the important discovery that a surprisingly small amount of milk as well as extracts of some other natural foods confer a nutritive adequacy on the otherwise insufficient ration.

Since then Osborne and Mendel²⁶ have demonstrated that the residual part of milk from which its fat and protein have been removed exhibited a growth-promoting or nutrition-promoting property when it was added to mixtures of the purified familiar foodstuffs. Subsequently, McCollum and Davis and Osborne and Mandel independently announced that the fat of milk also exerts a further growth-promoting influence, presumably due to something different from the known fats but presumably associated with them. Thus the significance of the vitamins—a water-soluble and fat-soluble type respectively—in milk became established.

The whole subject is carefully brought up to date in a recent editorial article²⁷ in which it is asserted that these discoveries have been verified for various species. The lack of either the fat-soluble or the water-soluble essential properties has been believed to lead to distinct pathological consequences when these vitamins are not replaced from other sources in the diet. Conversely, the presence of these "specifics" for good nutrition and growth contributes in no small measure to make milk the unique food that it is justly regarded to approximate.

Osborne and Mendel have more recently come to the conclusion that, from a quantitative standpoint, cows' milk is not as rich in the water-soluble vitamins as one not familiar with the experimental evidence for this property of the food might assume. This is in no sense to be

²⁴ Archives Latino-Americanos de Pediatria, March-April, 1918.

²⁵ Archives of Pediatrics, April, 1918.

²⁶ Journal of Biological Chemistry, 1918, xxxiv, 537.

²⁷ Journal of the American Medical Association, November 9, 1918.

construed as a denial of the "magical qualities" but rather as an argument for the more liberal use of milk when it is relied on mostly to contribute the growth-promoting factors in the diet. From a practical standpoint it appears not unlikely that the need of children and other animals for the water-soluble vitamine, beyond the earlier stages of development when milk admittedly satisfies the nutritive requirements, may not be fulfilled by some of the enforced or current dietary practices. With a too scanty allowance of milk a liberal inclusion of products from cereals, rendered poor in vitamine by milling, of sugar, fats and a few additional animal products other than meat (which has been shown to contain relatively little of the water-soluble vitamine), it is not surprising if disasters sometimes manifest themselves.

Another aspect of the significance of their quantitative studies of the vitamins in cows' milk has been presented by Osborne and Mandel in relation to milk dilution in infant feeding. It is a common practice to reinforce the supply of calories by diluting top milk and adding lactose. Under these circumstances we are reminded that the child is supplied with a food that contains a relatively smaller proportion of the water-soluble vitamine than does the original cows' milk. While milk thus modified may contain sufficient vitamine as long as the food intake is normal, if, for any reason, the child's appetite fails, the vitamine supply is reduced and endless dietary troubles easily result.

Without attempting to evaluate the actual degree of danger attributable to such causes in the artificial feeding of infants, we may well bear in mind the potentialities for harm. It may be that the babies of healthy mothers are born with a reserve supply of the so-called vitamine substances sufficient to maintain them in good nutritive condition until the time when they begin to eat other foodstuffs. If milk is not as rich in vitamins as is desirable at later stages of growth, there may be real wisdom in the practice of extending the diet as soon as the physiological conditions of the individual warrant the use of other foods.

Practical Points in Infant Feeding. Some very practical points are submitted by Vander Bogert,²⁸ of Schenectady. He believes that many nursing failures depend upon the elimination from the diet of the mother, foods supposedly harmful to the milk, and upon overfeeding of the mother in an effort to produce more milk. His own practice is to allow anything, acid or otherwise, which is not known to upset the digestion of the mother. The laity should be educated to the danger of underfeeding or of feeding an unbalanced diet. On the other hand, overfeeding is a frequent cause of failure of the breast milk. Vander Bogert advises three meals daily with milk only when there is an appetite for it, and at definite periods with relation to meal-times so as to allow of proper digestion and assimilation. Constipation is another factor which frequently reduces the milk supply.

The prescription of regular habits for the baby is just as important as for the mother. Irregularities as to nursing periods not only injure the baby but impair the breast milk as well. Too frequent night feed-

²⁸ New York State Journal of Medicine, January, 1918.

ings, often occasioned by the baby sleeping in the same bed with the mother, and the effort to get water into the baby between meals, by sweetening with sugar, together with irregular and too frequent feedings, are frequently causes of failure.

Many of the troubles of the second summer depend upon early over-feeding. We do not have to underfeed sufficiently to do harm. If there is a question whether the baby is suffering from real hunger or from tissue hunger the caloric value ought to roughly settle the point.

We can talk as much as we please about simplified feeding, but every baby will not thrive upon simple milk and water dilution even when boiled and with sugar added. Our whole ability to feed properly depends upon our ability to interpret symptoms and to elicit a history of past causes of trouble. A baby who has been fed on condensed milk, for instance, will not do well on another high sugar food. One upset by a high top milk mixture will not take cream well. A fat constipated baby will not be relieved by increasing the fat. We must know our history and our symptomatology better and then we will be more successful in giving artificial food.

Intestinal Intoxication. In an extensive and most scientific study of this subject, Schloss,²⁹ of New York, concludes that in intestinal intoxication there is a marked increase in the non-protein nitrogen and urea of the blood. This increase is not due directly to increased concentration of the blood from loss of water. The high non-protein nitrogen and urea are due to defective kidney elimination.

The renal lesions in intestinal intoxication are not sufficient to account for the impaired elimination by the kidney. It is probably due to the fact that lack of water restricts the amount of urine. This condition is probably due to the following factors, which may act singly or in combination: 1. The loss of water in the stools is so great that it is impossible for the infant to digest sufficient fluid to replace the loss. 2. The patient refuses to ingest fluid or vomits practically all that is taken. As a result, the tissues become dehydrated. The retention of nitrogenous waste products and the failure of the kidney to do its part in preserving the acid-base equilibrium result from the deficient secretion of urine. The oliguria may be due to the fact that the dehydrated tissues hold as much water as possible, so that none is available for the formation of urine.

Other factors dependent mainly on loss of water are: 1. An increase in the concentration of blood colloids to such a degree that their osmotic pressure is greater than the arterial pressure in the kidney. 2. A diminution in the total food volume tending to decreased blood flow through the kidney. The symptoms of intestinal intoxication are essentially those of uremia. The two conditions are similar in all essentials. In one, defective kidney function is due to an organic lesion, in the other it results from the negative water balance and consequent oliguria. Acidosis plays a definite part in the symptomatology of intestinal intoxication, but the essential cause is probably some unknown toxic agency.

²⁹ American Journal of Diseases of Children, March, 1918.

RHINOLOGY, LARYNGOLOGY AND OTOTOLOGY.

By GEORGE L. RICHARDS, M.D.

MILITARY OTOLARYNGOLOGY.

IN the review of this subject in *PROGRESSIVE MEDICINE*, March, 1918, reference was made to the establishment of sections for surgery of the head, and the personnel of the original organization of this division was given. In the Surgeon-General's Office, Surgery of the Head was classed as a separate division, but in the field it is one of the sections of the Surgical Division, the other sections being General Surgery, Orthopedic Surgery, Genito-urinary Surgery and Roentgenology. Lt.-Col. Mosher¹ thus describes the beginnings and make-up of the Section of Military Otolaryngology:

The medical officers composing the Division of Surgery of the Head, working with the Committee of the Council of National Defense, classified the names sent in in response to questionnaires, planned a special head building for each cantonment, selected instruments and advised in the selection of the personnel for the cantonment base hospitals in this country and for the base hospitals abroad. Lt.-Col. H. P. Mosher has had charge of the personnel department, Lt.-Col. Charles W. Richardson is in charge in the Surgeon-General's Office of the Reëducation of the Deaf. Major H. W. Loeb was given the position of editor of a war manual of *Otolaryngology*, consisting in the main of abstracts of war literature, with comments. He is also editing a periodical journal dealing with the specialities which compose a division of Surgery of the Head, to which journal this review is indebted for some of its material.

The Section of Brain Surgery has conducted a Neurological School in Philadelphia, New York and Chicago. The Section of Oral and Plastic Surgery has had a school in St. Louis and one in Chicago. Neither the section of Ophthalmology nor that of Otolaryngology has undertaken separate schools, but has drawn in its personnel from the leading members of these specialities throughout the country. At the Officers' Training Camp at Camp Greenleaf all branches of medicine and surgery are being taught or reviewed, Lt.-Col. Thomas J. Harris having charge of Otolaryngology. A special hospital for Surgery of the Head has been started at Cape May. Appropriate cases are sent there as they are returned from overseas, and it is to act as a hospital of last resort for head cases occurring in the hospitals in this country. The building used for the hospital is a hotel beautifully situated and holding about 500 patients.

For purposes of administration, the section of Surgery of the Head has an independent existence in the Surgeon-General's Office and a semi-independent existence in the base hospitals. While coördinate

¹ *Annals of Otolaryngology*, June, 1918.

with the main services of medicine, surgery and laboratories, it has been allowed practically an independent career. Overseas this section is gradually achieving a definite position. Lt.-Col. Blair has been appointed by the Chief Surgeon, A. E. F., as consultant for Oral and Plastic Surgery. Lt.-Col. McKernon, of the Post-Graduate Base Hospital, has been appointed a consultant for Otolaryngology, Lt.-Col. Greenwood in Ophthalmology and Lt.-Col. Cushing in Brain Surgery.

Otolaryngology is not yet recognized as a specialty in the English Army, but it is in the French Army, and in Italy the Italians have gone even further than the French in specializing their surgery. All American otologists who have been in Italy have come back greatly impressed with the efficiency of the Italian surgery. In the cantonments there are 16 base hospitals for the National Army and 15 for the National Guard. In the cantonment base hospital the death-rate is low, since the soldier citizens are chosen as physically fit before they take up their residence there. The sick-rate is low, but not so low as would naturally be expected, since it soon became evident that the grouping of apparently well young men was followed by epidemics of disease, especially infectious diseases of childhood, tonsillitis, pneumonia and cerebrospinal meningitis. The latter, rare in civil life, has become almost common in the cantonment. An apparently well man is often the carrier of bacteria, which he gives to his fellows. Men who have long lived together seem to acquire immunity to each other's bacteria, but assemble them as strangers in large numbers, and infectious diseases at once appear in spite of the healthy mode of life. The food and drink infections have been practically stamped out, but the breath-borne infections, the bacteria of which live in some part of the respiratory tract, especially the nose and throat, are yet to be conquered. There are no vaccines for most of these diseases, though efforts in this direction, successful to a more or less degree, and offering promise in the future, have been made in the present influenza epidemic by Leary, of Tufts College, and others. Persons using these vaccines seem to have acquired, if not an immunity to influenza, a certain resistance, the attack being much milder than in the case of the person who has not received the vaccine. When men come to camps, the problem is to find out what soldiers are carriers of disease and isolate them before they can infect their mates. As the men come to camps, cultures from the nose and throat can be taken, and all soldiers found to be carriers can be isolated and treated. This problem of the carrier is the acute medical problem of the cantonment, and it is becoming more evident that the nose and throat are the abode of choice of the streptococcus, pneumococcus and many of the other organisms responsible for the infectious diseases.

Masks. Striking results in the control of infectious diseases have been obtained by the use of gauze masks, and in measles and influenza the use of the gauze mask has been made compulsory. If every soldier on a transport had been required to wear a gauze mask when below or between decks, or if every soldier had been required to carry a piece of gauze and to cough into it during the winter season, it is probable that the percentage of disease in men landing in France, ill with acute or chronic pharyngitis, acute or chronic tonsillitis, acute or subacute

bronchitis, would have been very much reduced during this last winter. Experience in the present influenza epidemic is certainly confirming the opinion here advocated by Mosher.

Weaver,² in two communications, describes the ideal mask. These are made of gauze, 44 by 40 mesh, cut 8 inches wide and 23 inches long. The sides and one end are turned down $\frac{1}{4}$ inch. It is folded twice, the unturned end first, making a $7\frac{1}{2}$ inches square. The opposite diagonal corners are cut off 1 inch and the raw edges turned in $\frac{1}{2}$ inch. They are stitched firmly all around. A 1-inch dart, $1\frac{1}{2}$ inches long, is taken up at the middle of each side of the mask. A 14-inch tape is sewed on the opposite corners. This mask has the advantage of covering the nose and mouth and of making a traction on the chin and not drawing on the nose and lips. Experiments made in the use of these masks with streptococcus viridans showed that the fine gauzes removed most of the bacteria, and if six or eight layers were used almost all of the bacteria were held back. There appeared to be no appreciable difference in dry and moist gauze in filtering properties. Since three or four layers of gauze, with a mesh of 44 by 40 mesh, removed most of the bacterial spray thrown with unusual force at a short distance, further tests were carried out to learn how efficient as filters of mouth spray three layers of this gauze would be when placed over the mouth of the person discharging the spray and over an exposed blood-agar plate, at varying distances, corresponding to the face of the person in the neighborhood. The plates were placed vertically. The expiratory effort consisted of two strong coughs, with the lips slightly parted. When the gauze mask was over the face, very few colonies developed in the plate. A general use of these masks on the person of the patient, the attendant and the physician would probably lessen the spread of many of these contact infections. They should be used not only by the nurses, but by physicians in taking cultures from the throat, doing intubations and examining chests. The mask on the face interferes with putting the hands to the mouth and nose, and so becomes indirectly a source of safety to the individual, whose hands are apt to be contaminated in his work and who thoughtlessly may put them to the face. Masks should be used by mothers while nursing their babies, in case either one has been infected by diphtheria or been a diphtheria carrier. In Camp Grant these masks have been used extensively by Capp,³ and have since been generally adopted in army and navy camps. The use of face masks should not take the place of proper sterilization of eating utensils, the destruction of infectious discharges and thorough washing of the hands every time the sick are handled.

To obviate the mechanical difficulties attendant in the use of face masks, which are, in a sense, uncomfortable, do not remain in position and cause fogging of eye glasses, Dannenberg,⁴ of Camp Jackson, suggests the use of galvanized wire mesh. A piece of galvanized wire of the size used for screening purposes is cut. The size varies with the requirements of the individual physiognomy. The measurements

² Journal of the American Medical Association, January 12, 1918, p. 76; October 26, 1918, p. 1405.

³ Ibid., August 10, 1918, p. 448.

⁴ Journal of the American Medical Association, April 6, 1918, p. 990.

are for the average male face. The edge of the mask is bound by adhesive plaster to protect the face from the wire points that are present. A piece of tape is then sewed in the center of both sides directly through the wire and adhesive binding. Gauze, usually of double thickness, is cut $\frac{1}{4}$ inch larger than the mask and placed on the latter with its edges turned under to prevent fraying. The gauze is then sewed either directly to the mask or fastened by means of brass paper clips. The clips permit rapid replacement of the gauze when necessary. The mask is then molded to fit comfortably over the nose and mouth, and is held in position by the pieces of tape, which are brought over the ears and tied under the occiput. To facilitate the putting on of the mask, its quick removal, or its better adjustment on the face, an elastic tape may be used in lieu of the non-elastic one.

The advantages of this mask are: (1) complete protection; (2) simplicity; (3) ease of manufacture; (4) economy in the use of gauze; (5) ability to wear it without the eye glasses becoming foggy; (6) permanence of position on the face.

Examination of Recruits. Not the most dramatic part of the medical officers' work⁵ in the army, but the most important part, is keeping the fighting men well, and one of the most important parts in the making of a good soldier is in seeing that he has a normal nose and throat, either by nature or by operation. This requires that the army surgeon shall be an expert in opening peritonsillar abscesses, in resecting the septum, in tonsillectomy, in mastoidectomy and in sinus surgery.

During the past year several million men have been examined through the medium of the Selective Service Organization and at Base Hospitals. As a result, the standards of physical examinations have been more or less changed from time to time. Revised Form 75, issued October, 1918, gives the following as the Ear, Nose and Dental requirements. The dental requirements are set down because they have such close relationship to otolaryngology. It will be noted that the test for malingering is slightly different from those given in the volume of last year, the Wagner Malingering Phone not being mentioned, and the experiment with the C² tuning-fork being dignified with the term Chiman-Moos test. This was given in the tests as published a year ago.

TESTS OF HEARING. Place the registrant facing away from the assistant, who is twenty feet distant, and direct him to repeat promptly the words spoken by the assistant. If the registrant cannot hear the words at twenty feet, the assistant should approach, foot by foot, using the same voice, until the words are repeated correctly. Examine each ear separately, closing the other ear by pressing the tragus firmly against the meatus; the examiner should face in the same direction as the registrant and close one of his own ears in the same way as a control. The assistant should speak in a low conversational voice (not a whisper), just plainly audible to the examiner, and should use numerals, names of places, or other words or sentences until the condition of the applicant's hearing is evident. The acuity of hearing should be expressed in a fraction, the numerator of which is the distance in feet at which the words

⁵ Report on Otolaryngology in the First Year of the War, H. P. Mosher, *Annals of Otology*, June, 1918.

are heard by the registrant and the denominator the distance in feet at which the words are heard by the normal ear; thus 20/20 indicates normal hearing and 10/20 partial hearing of a degree indicated by the fraction. If any doubt as to the correctness of the answer is given, the registrant should be blindfolded and a watch should be used, care being taken that the individual does not know the distance from the ear at which it is being held. The watch used should be one whose ticking strength has been tested by trial on a normal ear.

Registrants who present the following conditions, who are otherwise mentally and physically fit, shall be unconditionally accepted for general military service: (a) Normal hearing; (b) hearing in each ear of 10/20 or better. Registrants who, on examination, present the following defects, who are otherwise mentally and physically fit, may be accepted for special and limited military service: (a) deafness in one ear with normal hearing in the other ear; (b) hearing in one or both ears less than 10/20 but more than 5/20; (c) perforation of membrana tympani without discharge, definitely determined by otoscopy; (d) loss of one or both external ears, if the registrants have followed a useful vocation in civil life and the deformity is not too greatly disfiguring. Registrants, who on examination, present the following defects shall be unconditionally rejected for all military service: (a) Hearing in one or both ears of less than the minimum hearing required for special and limited military service; (b) chronic purulent otitis media, with or without mastoiditis. The Local Boards shall refer to the Medical Advisory Boards, or to a specialist member thereof, all registrants who are found giving a history of chronic discharge, or have a chronic discharge of the middle ear or ears, or whose hearing is in doubt.

TESTS FOR MALINGERING IN HEARING. Individuals who are malingerers in regard to hearing usually claim magnifications of slight imperfections on one side with a complaint of past trouble. Exaggeration of defects in hearing extends usually to declarations of total deafness on one side. The following directions should be observed in examining suspected malingerers: (a) In making these examinations the observer should have a skilled assistant and all communications between them should be in a low whispered voice. (b) The assistant should stand at the back of the patient and should at the direction of the examiner obstruct the ears of the suspect as directed, by pressing the tragus firmly into the auditory meatus. (c) The suspected malingerer should be placed in the center of the room, free from all obstructions; his eye should be securely and completely blindfolded. (d) An accurate notation should be made of which ear is deaf as claimed by the registrant; then a critical examination of the auditory canal, membrana tympani, and for the patency of the Eustachian tubes should follow. (e) Then an accurate test of the normal ear should be made; care should be exercised not to allow the suspect to hear figures or other signs as to the result of examination. (f) If the suspect gives markedly conflicting statements, when the normal ear is tightly plugged, as to the distance at which he hears the voice or a acoumeter, it is fair to assume he is a malingerer. (g) The simplest and most available test for malingering is the use of an ordinary binaural stethoscope; one earpiece, the one to be applied to the

normal ear, is packed tightly with a wad of absorbent cotton, and the ear-pieces are placed in the suspect's ears; the examiner speaks in a soft tone or counts into the bell-shaped chest portion of the stethoscope, and the suspect is told to repeat what he hears; the tubes are removed from the ears, and the assistant is told to stop the normal ear; the same words or numerals are again repeated; the suspect will now claim failure to hear the words or numerals which he had previously heard through the tube with the ear stated to be deaf. (h) Erhard's test is another simple method for malingerers which requires no special apparatus; if the external auditory canal of a normal ear is tightly packed with absorbent cotton, it will still conduct sound waves to a limited degree; a loud-ticking watch even under these circumstances being heard about 1 or 2 meters; the suspect has his ear, which is stated to be deaf, stopped, and then the test is made with the hearing of the normal ear, the suspect being told to count the ticks of the watch; the suspect's normal hearing is then stopped and the testing is made with the supposed deaf ear; under this test if he claims failure to hear the watch under 1 meter he is malingering. (i) The Chiman-Moos test is made with the C² tuning-fork. The vibrating tuning-fork is held at equal distances from each ear. The suspect may claim that he hears it better in the normal ear. The vibrating tuning-fork is then placed on the vertex of the skull. The suspect hearing it equally well in both ears will at first hesitate, and then state he hears it better in the normal ear. In diseases of the conducting apparatus he should hear it better in the diseased ear. If now the external meatus of the normal ear is tightly closed and the vibrating tuning-fork is placed upon the vertex of the skull, the individual with the diseased ear will state he hears it better in the normal closed ear; or it may be impossible for him to decide in which ear he perceives the tone better. The suspect, with the normal ear tightly obstructed, will state that he does not perceive the sound of the fork when thus placed on the vertex of the skull.

MOUTH, NOSE, FAUCES, PHARYNX, LARYNX, TRACHEA AND ESOPHAGUS. Registrants who on examination are found to present the following conditions, who are otherwise mentally and physically fit, shall be unconditionally accepted for general military service: (a) Normal conditions of the mouth, nose, fauces, pharynx, larynx, trachea and esophagus; (b) enlarged tonsils; (c) adenoids; (d) small benign tumors of the nasal and buccal mucous membrane; (e) deviation of the nasal septum which does not seriously interfere with nasal breathing; (f) acute primary sinusitis provided the acceptance of the registrant is temporarily deferred for reexamination, if after a reasonable time the sinusitis has disappeared; (g) laryngitis manifested by hoarseness, laryngeal cough and congestion of the vocal cords, confirmed by laryngoscopy; (h) paralysis of the vocal cords, if it appears to be temporary in character; (i) aphonia without objective findings by laryngoscopy or other measures, and which in the opinion of the examiners is due to functional nervous conditions; (j) alleged stricture of the esophagus which is unattended by evidence of organic disease of the esophagus as shown by the passage of a stomach tube or an esophageal bougie, or by fluoroscopic examination while the registrant is swallowing a bismuth mixture.

Registrants who on examination present the following defects, who are otherwise mentally and physically fit, may be accepted for special and limited military service: (a) Deviation of the nasal septum, though it markedly interferes with nasal breathing; (b) paralysis of the vocal cords, and which does not appear temporary in character, if it permits the registrants to follow a useful vocation in civil life; (c) aphonia, with attendant conditions, which disqualify for general military service, if they have followed a useful vocation in civil life; (d) partial ankylosis of the lower jaw; (e) perforation of the hard palate; (f) moderate deformity of the structures of the mouth which does not seriously interfere with mastication or speech.

Registrants who on examination present the following defects shall be unconditionally rejected for all military service: (a) Irremediable deformities of the mouth, throat and nose which interfere with the mastication of ordinary food, with speech or with breathing; (b) tuberculosis of the structures of the mouth, larynx, fauces, nose or esophagus; (c) cancer of the structures of the mouth, nose, throat, larynx or esophagus; (d) destructive syphilitic diseases of the mouth, nose, throat, larynx or esophagus; (e) laryngeal paralysis, due to pressure from aneurysm or tumor; (f) permanent tracheostomy; (g) stricture of the esophagus; (h) permanent gastrostomy; (i) chronic sinusitis of the accessory sinuses of the nose; (the diagnosis should be established upon chronic nasal discharge, presence of large nasal polypi and other signs and symptoms reinforced by transillumination or x-ray plate, or both); (j) chronic atrophic rhinitis with offensive odor (ozena).

DENTAL REQUIREMENTS. Registrants who on examination are found to present the following conditions, if otherwise mentally and physically fit, shall be unconditionally accepted for general military service: (a) Normal teeth; (b) a minimum of three serviceable natural masticating teeth above and three below opposing and three serviceable, natural incisors above and three below opposing. (Therefore, the minimum requirements consist of a total of six masticating teeth and of six incisor teeth. All of these teeth must be so opposed as to serve the purpose of incision and mastication.)

Registrants who on examination are found to present the following defects, who are otherwise mentally and physically fit, may be accepted for special and limited military service: (a) Dental defects which are greater than the minimum dental requirements for general military service.

Definitions. (a) The term "masticating teeth" includes molar and bicuspid teeth, and the term "incisors" includes incisor and cuspid teeth; (b) a natural tooth which is carious (one with a cavity) which can be restored by filling is to be considered as a natural, serviceable tooth; (c) teeth which have been (see (b)) restored by crowns or dummies attached to fixed bridge-work, if well placed, shall be considered as serviceable, natural teeth, when the history and the appearance of these teeth are such as to clearly warrant such assumption; (d) a tooth is not to be considered a serviceable, natural tooth when it is involved with excessively deep pyorrhea pockets or when its root end is involved with

a known infection that has or has not an evacuating sinus discharging through the mucous membrane or skin.

A New Hearing-test Apparatus. Prem⁶ offers a new hearing-test apparatus, and Figs. 13 and 14 give an illustration of the apparatus. The patient sits in a chair with both earpieces adjusted closely to his ears. The examiner stands behind him. The sound carrying from the examiner to the patient is not affected by the length of the tubing. The ones used in this illustration are five feet long, but the writer has also used ten and twelve feet of tubing with the same result. The examiner whispers into the speaking tube numbers or letters of different scales, such as 99, 44, 55 or 66 or a 00 and s, first with both tubes open, then by compressing one tube or the other, thus shutting off the sound to the correspond-



FIG. 13

ing ear. If the patient claims deafness of the left ear, for instance, the right tubing is compressed and *vice versa*. The tuning-fork is of more positive value. A tuning-fork of 64, 125, or 512 seconds is struck and the prongs are applied to the lumen of the speaking-tube, which tests the air conduction of the patient. Then the tuning-fork is struck again and the handle is gently applied to the rim of the speaking-tube or over the rubber, as, for instance, of the stem of the "Y" piece metal, which tests the bone conduction of the patient. The order may be reversed. Here, again, by compressing one tube or the other, or by telling the patient to remove one earpiece or the other, the air or bone conduction, respectively, is tested separately from the same median point. The patient is in no wise aware whether the air or bone conduction is being

⁶ Boston Medical and Surgical Journal, June 27, 1918.

tested. It may be used ordinarily without confusion to the patient, and with time-saving to the physician. (Weber and Rinné tests.) It is particularly intended for use in cases of suspected malingering, in doubtful cases in the examination of recruits, and in certain accident insurance cases. In absolute nerve deafness the labyrinthine test, of course, will have to be resorted to.

Ear Protectors. The subject of a proper ear protector,⁷ to prevent injury to the conductive and receptive apparatus of the auditory mechanism, that will be serviceable under all forms of gunfire, has been the quest of military surgeons for several years. At the inception of the present war, July 30, 1914, experimenters in none of the belligerent countries had perfected an efficient ear protector.

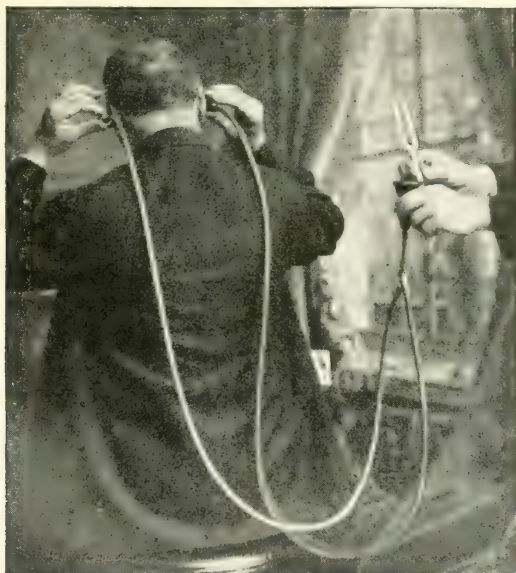


FIG. 14

In the Navy, where the conditions were more acute, on account of turret firing of great guns, the medical officers and the gun crew had practically given up the use of patented devices and depended almost alone on the efficiency of dry or moist absorbent cotton. Since the great increase in number of those permanently disabled as the result of the handicap of loss of hearing, otologists in the service in all countries have sought more diligently, and have experimented more actively, to find a device that will be safe, efficient and not impair the hearing too greatly, in preventing injury to the conductive and receptive apparatus, and that may be worn with comfort.

The satisfactory ear protector must embody three important features: (1) Applicability; (2) safety; (3) cheapness. All types of hard and

⁷ Richardson: Transactions of the American Otological Society, 1918.

metallic forms of protectors are dangerous, because, in cases of gunshot wounds or shrapnel wounds about the auricle or canal, they are likely to become secondary foreign bodies. Some of the cheapest, while fairly good protectors, should be ruled out, because they cut off the conduction of air sounds too greatly. There is no question, through all of our experimentations, but that we have found one actual protector in what is known as the British Tommy, manufactured by George F. Berry, 4 Cullum Street, Fenchurch Street, London, E. C. This device is simple, easy to introduce, and causes no undue pressure, and is easy to remove. While it cuts down the hearing, it does not cut it down sufficiently to impair the voice beyond military needs. It prevents impact of concussion upon the membrana tympani, the conducting apparatus; it is safe; there is no possibility of forcing it in against the membrana tympani; it is not likely to be any more conducive to secondary foreign bodies than anything that could be worn in the war; and it is comparatively cheap.

Another protector to be seriously considered is the Baum, modified from the British Tommy, and further perfected since the publication of Col. Richardson's⁸ article. Fortunately, it is probable that these devices will not be needed for military use in the field, but should be worn for practice work and by boiler makers and industrial workers who labor in very noisy places. Its essential features, in the language of its originator, are: "(a) The three sound-arresting and absorbing barriers or antiphones therein produced, which prevent the entrance of air, sound waves, detonations or convections of concussion violence without interfering materially with military commands. (b) The hollow body on the outer surface of which is provided longitudinal ventilating and drainage grooves which prevent compression or change of pressure and distressing disturbances of headache and dizziness, and suction upon the ear drum and canal during either insertion or withdrawal. (c) The novel construction of the cap or cover to this hollow body, which hermetically seals the air-chamber, forming a pneumatic cushion to resist concussion violence, prevents labyrinth disturbances and is believed to prevent deafness from long-continuous and excessive noise; at the same time, it carries appended to the cover within this chamber, a pendulum-like sound-absorbing vibrator, which prevents bone conduction, and, in conjunction with the thumb and finger grasp knob on its outer side, performs the synergetic duty of an inserter at the time the ear protector is placed within the ear, and permits the wearer to often and readily remove or insert the stopper more quickly than a second. (d) The diaphragm cover which seals the pneumatic air-chamber also acts as a barrier to concussion violence or vibrations, prevents loss of tissue by the entrance of missiles, or the entrance of gas-producing irritation or caustic action in the canal or drum. (e) The conformable outer shape of the whole device enables it to adjust itself to ear orifices of greater or lesser diameter, and the fact that the device is made of pure non-sulphurized gum of highest resiliency causes it to

⁸ Transactions of the American Otological Society, 1918.

act as a buffer and preventive of bone conduction to the violent concussion vibrations, by reason of its superior resilience, preventing the driving in of the device or injury to the point of presenting any injurious force spent upon the drum to the degree of forcing in the foot plate, with the membrani tympanum intact."

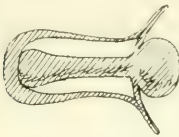


FIG. 15.—Cross-section when entering.

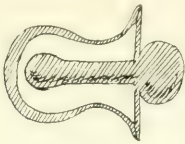


FIG. 16.—Cross-sections when seated.

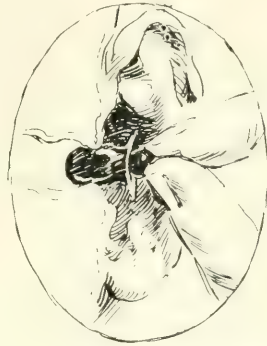


FIG. 17.—Manner of inserting.

It is very simple (Figs. 15, 16), very easily introduced into the ear (Fig. 17), and as easily removed. It can be worn for longer or shorter periods without causing any inconvenience to the patient. It is light in weight, and there are practically no dangers attending upon its wearing as regards secondary foreign bodies.

Cotton protectors saturated with glycerine or vaseline are the cheapest of all; most available, easy to obtain, constantly at hand. They are practically within the reach of every soldier. Soldiers are very much inclined to use cotton in the dry state. It is only in the wet state that it is of any value to prevent shock concussion. This wetting should be done preferably with glycerine or with vaseline. Either one impairs the conduction of sonorous sound waves. Therefore, while it is the cheapest, the most easily available, one that is most likely to be used, it has the disadvantage of deafening the wearer more than any other.

Shell Shock Deafness. Col. Richardson⁹ finds the cases characterized as "shell shock" the ones in which the element of bone conduction seems to play the most important role. Here we have a most intense, sudden and violent vibration of the atmosphere produced by the detonation of a single highly explosive shell. We have not only the concussion impression made upon the auditory apparatus, but also upon other organs within the body and not in relation with the external atmosphere. There are a large group of cases, properly designated as concussion deafness, in which the element of aural conduction plays the all-important part. Bone conduction enters only to a minor degree in the development of these cases. These cases are those which are attended with marked impairment to complete loss of hearing. Very few of these cases show any tendency to improvement or to the restoration of their

⁹ Transactions of the American Otological Society, 1918.

hearing. They are mostly due to the prolonged exposure to highly explosive shells, shrapnels, grenades, and the constant rattle of machine guns.

J. S. Fraser,¹⁰ shows that out of 4 cases of explosion injury of the ear microscopically examined, (1) rupture of the delicate neuro-epithelial sacs and tubes of the membranous labyrinth was not found in any case; (2) hemorrhage into the cochlear nerve at the fundus of the internal meatus was present in 3 out of 4 cases; such change is quite capable of producing deafness; (3) an early stage of degenerative neuritis was probably present in one case.

Wilson¹¹ has been able to study cases of war deafness at times varying from twenty hours to over eleven months after their injury. Previous wars have brought forth extremely few cases of deafness without direct injury to the ear by missiles. This was a war of high explosives and tremendous shells, weighing from many pounds to a ton, and containing as much as 200 pounds of high explosive in a single shell. Some idea of the frequency of ear affections resulting in the present conflict can be obtained from the statistics of French observers who found some degree of war deafness in 16 per cent. of the total injured and 4.5 per cent. of the total of those evacuated to bases. He thinks these figures are rather too high but they serve to indicate the great number of cases of incapacity which are caused through deafness.

The cases of deafness due to war conditions can be divided into two main classes: one including all cases in which there has been a direct wound of the ear by a missile, and the other including those injured by the effects of an explosion without direct wound of the ear. The effect of a high explosive is a great and sudden compression followed by an equally great and sudden decompression. This compression and decompression could amount to 10,000 kilograms in a square meter. The men with symptoms of nerve deafness, due to the effects of high explosives, can be classified as those with true nerve deafness; those who had had nerve deafness and who retained the fixed idea that they could not hear; and those who were malingering.

Concussion Deafness. Jones-Phillipson¹² has studied a large number of cases of concussion deafness occurring in the present war. An analysis of the symptoms, in their order of frequency, shows: (1) Deafness, increased deafness, "dulness in ears;" (2) noises in great variety (singing, buzzing, hissing, straining, thumping, bells, throbbing, ticking); (3) giddiness, dizziness, "dazed;" (4) pain, soon passing off; (5) bleeding at the time or noticed soon after; (6) staggering gait, inability to walk, unconsciousness, dumbness, blindness.

Deafness was very marked soon after the explosion, always most on the side exposed to the full force; when the shell burst in front or behind a patient, both ears were affected. Patients who had been buried seem to have suffered more than others. The initial degree of deafness

¹⁰ Hysterical Deafness in Soldiers, *Lancet*, 1917, ii, 872; *British Journal of Laryngology, Rhinology and Otology*, November and December, 1917.

¹¹ *New York Medical Journal*, February 23, 1918, p. 357.

¹² *Journal of Laryngology, Rhinology and Otology*, March, 1918.

following the concussion soon passed off. The noises were often noticed only later, after the first degree of deafness had disappeared. It was not often that increase in deafness was stated; as a rule, only the addition of noises to the previous condition. When the hearing showed further marked improvement, the persistence of the noises was a common complaint. Some patients reported being unconscious for from one to two hours; then feeling in a dazed condition, inability to walk unassisted, staggering gait; others that they lost the power to speak, or could not see. All these maximum conditions appear to pass off quickly; the lesser conditions, giddiness and dizziness, were complained of for seven, ten or fourteen days—anyway while under observation. These cases showed a horizontal or rotary nystagmus on turning eyes to the right or left. The caloric tests require very much more water to prove a functioning or non-functioning labyrinth in the cases at the Front than in civil life, because these ears have been profoundly disturbed. One cannot tell whether a labyrinth is functioning unless the test with hot or cold is continued for three times as long as normal. Shell-concussion deafness is probably due to three contributory factors: (1) Cerebral concussion; (2) overstrain and fatigue of the organ of Corti, the former being due to violent oscillations of the perilymph communicated to the organ of Corti, and the latter to continuous violent noises or explosions at close quarters; (3) temporary or permanent disorganization of the conductive apparatus.

The prognosis depends on the recovery of these parts. (1) The patient experienced a great shock and was in many instances buried. He became suddenly deaf, and often dumb also. In other cases, he could not see, or had paresis of arm, leg or both legs. Here the higher centers were temporarily involved. One watched the almost sudden improvement in hearing in a few days as shock passed off, and the disappearance of nervous symptoms generally when the patient was removed from the firing line. (2) A portion of deafness remains to be more or less slowly recovered from by the return of the internal ear to a normal or nearly normal condition. (3) Structural damage must leave a permanent imperfection of function—a ruptured membrane; a dislocation, partial or complete, of the small bones from one another, or the stretching of their attachments to the tympanic wall. These, in other larger but similar conditions, are only slowly recovered from, if ever, in many instances. He quotes from cases seen three or four months later, showing a great recovery of hearing. The loss in these cases was practically due to the macroscopic structural damage, and to the frequent sequela of chronic otitis media suppurativa. The information gained from the cases shows shell-concussion deafness to be, to a large extent, temporary and curable.

Wilson,¹³ studying the perforation of the tympanic membrane following exposure to high explosives, found these perforations to be variable in size and one or two in number. If of small size, spontaneous closure usually occurs. If of large size, suppuration, with adhesion of the mal-

¹³ British Medical Journal, March 17, 1917, May 5, 1917.

leus to the internal wall, frequently follows. Disturbances in equilibrium with nerve deafness, may occur with or without ruptures, and may last for a long time or only for a few days. The disturbance of equilibrium lasts longer than the deafness, but both may be permanent. For treatment, the blood clot over the perforation is left intact, and the whole ear carefully dried; the cotton pledget is left in the outer meatus. Keep in bed for ten days to allow the effects of the concussion to subside.

Castel's¹⁴ experiments with the effects of explosions on rabbits and guinea-pigs showed that, as a rule, the middle ear is not affected. The most frequent lesion was a dislocation of the cochlea from the second spiral turn. Corti's organ was much damaged, and there was evidence of much hemorrhage with apparent atrophy of cells. The vestibular organs did not show traces of injury.

Wicart¹⁵ says that deafness due to pure concussion of the labyrinth soon disappears upon local and general rest. If a dry traumatic perforation of the drum exists, the ear should be rested and disinfected with a gauze wick impregnated with glycerine, oil of lemon or lavender, filling the canal completely and changing twice a day. In old dry perforations put in iodine and iodine glycerine, iodine 1, iodine glycerine 4, and retain fifteen minutes. A gauze plug should be kept in the ear in the interval. After a week or two, tincture of iodine or iodine solution, with or without glycerine may be used, and carried by means of cotton on a fine hook through the perforation once in three days. This is used with the idea of checking suppuration completely in all recesses, and obviating or dissolving scar formation. Cocain-adrenalin anesthesia is necessary as a preliminary. Although alcohol favors healing, it promotes deafness and is to be avoided.

Various *methods* have been tried for the *improvement of hearing* in the several types of nerve deafness, but none has been found to be of the least value in cases in which the internal ear is destroyed. In other cases, whether totally deaf or partially so, the most successful plan of treatment includes the use of tuning-forks applied to the bones, through resonators and through the air, and the use of the voice through resonators, speaking tubes and the air. These normal stimuli are applied for short periods twice daily until there are some signs of restoration of function, and, when this once appears, the treatment is continued until, in many cases, marked improvement is obtained. Electricity is of no value; is actually harmful in many cases. It is noted that often the patient will hear the sounds but will be very slow in appreciating them and recognizing them. The ability to recognize sounds usually returns but may always remain somewhat slow, so that words will have to be repeated several times before they are understood.

Mastoiditis. Lathrop¹⁶ reports on acute mastoids as a complication of infectious diseases based on a study of 120 cases in a base hospital, Camp Shelby, the camp having suffered an epidemic of acute mastoiditis of streptococcic infection. This streptococcic invasion of the ear was

¹⁴ Paris Medical Journal, March 10, 1917.

¹⁵ Bull. de l'Acad. de Méd., Paris, 1917.

¹⁶ Journal of the American Medical Association, August 10, 1918, p. 45.

only one of a general wave of streptococcic invasion incident to that camp, and all the camps throughout the Southern Army in which the streptococcus viridans was the etiological factor and not the hemolyzing streptococcus. It involved, with unusual severity, the middle ear and mastoid tissues, beginning chiefly in the mastoid developing after measles, which stands by itself as an etiological factor in the development of the severer types of mastoiditis. In all, 123 soldiers developed acute mastoiditis of one or both sides. Invariably, there was a preceding middle ear involvement, though in several cases the invasion of middle ear and mastoid had the appearance of being synchronous, so rapidly did the infection mature. It was a common occurrence that a patient complained in the night of earache, and the next morning was found to have a reddened, bulging drum, which would be opened at once. Mastoid tenderness was an accompaniment of the middle ear symptoms, and the second morning, the tenderness persisting, and the temperature remaining high, even with free drainage, the roentgenogram would reveal a cloudy mastoid, leukocytes would be high, and at operation within forty-eight or seventy-two hours of the onset of the first symptoms an extensive involvement of the mastoid, with necrosis and thick pus, would be found. Bacteriologically, there were 29 cases in which the prevailing organism was the streptococcus viridans; in 17 cases, streptococcus and staphylococcus; in 13 cases, staphylococcus; in 8 cases, streptococcus and miscellaneous; in 5 cases, streptococcus hemolyticus; in 9 cases, miscellaneous, and in 42 the organism was either negative or not taken.

Fowler¹⁷ describes the same epidemic. Every patient had his head swathed in the gauze turban which connotes mastoid operation. Several patients had attained special distinction; they had had a double mastoid operation. The cases continued to multiply. The staff was busy day and night through January and February, in the effort to stem the tide of what is fairly described as an epidemic of mastoiditis. Fresh cases were sent to the hospital constantly. One man developed mastoiditis in the ward where he had helped as orderly to dispose of the waste gauze for the otitis patients, and a member of our own medical staff developed mastoiditis of the fulminating type. It is enough to make a thoughtful man ponder when a thing so extraordinary, so unheard of, is seen. An average of two new patients with mastoiditis were admitted daily over a long period of weeks, and there was presented in this series the cumulative evidence of the presence of a virulent organism; an organism that was communicable, and that had a specific tendency to affect such tissue as the mastoid cells. The best results were obtained under these conditions by doing a prompt paracentesis in the acute otitis cases, and an early mastoid operation when there was purulent mastoiditis, besides taking special precautions against the infection spreading in the hospital.

Pierce,¹⁸ at Camp Grant, had a somewhat different experience. He reports only 13 cases in which the mastoid was operated on for acute mastoiditis. This is in strong contrast to the experience of some of the

¹⁷ Journal of the American Medical Association, August 10, 1918.

¹⁸ Annals of Otology, September, 1918.

other cantonments. He explains it by the fact that one of the officers had for his duty the daily inspection of the wards for contagious diseases, so that whenever an otitis media developed in these cases, it was immediately detected and a very early myringotomy was performed. Bulging or rupture was never waited for. The myringotomy was done under strict antiseptic precautions. The external auditory canal was disinfected and washed, then painted with iodine as a preliminary. After the tympanic membrane was incised, a 50 per cent. alcohol dressing was placed over the ear and mastoid region. He thinks the ceaseless painstaking care of these cases one of the reasons why so few came to operation.

Radical Mastoid Operation. Dench¹⁹ urges the reconstruction by radical operation of all cases of suppurative otitis media, occurring in persons who are otherwise fit for military service. Accumulated statistics on the result of the radical operation in competent hands have shown that this operation is as free from danger as any operation in surgery. If the most approved methods of technic are employed, and the primary graft is used in every case, when possible, the period of convalescence in the hospital will seldom be over three weeks, and often not over two. These cases then go out perfectly fit for general military service. In a certain small proportion of these cases, there will be a slight mucous discharge from the ear from the region of the tube. It must be remembered that this discharge coming from the region of the tube constitutes no menace to the patient's life, and that it is not profuse enough to make him an object of disgust to those with whom he is brought in contact. It requires no more attention at the hands of the patient than does the washing of his face and hands. In addition, the hearing is frequently greatly improved.

Dench is in the habit of classifying all cases of middle ear suppuration under six heads: (1) Cases of small central perforation; in these cases there is usually a history of intermittent discharge; the condition is seldom serious, and is usually easily relieved by local treatment. (2) Cases of large, kidney-shaped perforation without caries of the ossicles, and with the mucous membrane of the middle ear either dry or moist. When the mucous membrane is dry and dermatized, the condition is a residual one, and constitutes no menace to life, and the patient is perfectly fit for military duty, provided the hearing comes up to the standard prescribed by the Government. (3) Cases of large, kidney-shaped perforation with the presence of granulation tissue. In these cases there is always a profuse discharge. The presence of granulation tissue may mean one of two things, either carious bone in the tympanic cavity, or lack of cleanliness. The patient should be put in the hospital, and the granulation tissue removed, and the ear kept clean by irrigation. If at the end of a couple of weeks these ears become dry, the case becomes then a case of large kidney-shaped perforation with a dry ear, or with an ear from which there is only a slight discharge. Depending, then, upon the degree of hearing, this case can be accepted for general military

¹⁹ Transactions of the American Otological Association, 1918.

service or limited military service. (4) Those cases in which there is a perforation in the upper posterior portion of the membrana tympani, with a sinus leading into the tympanic vault. The remainder of the drum membrane may be somewhat thickened, but frequently remains perfectly normal. The lower margin of the perforated drum membrane has become adherent to the internal tympanic wall, while the epithelium of the drum membrane has spread over the internal tympanic wall. In such cases there is usually a history of only very slight discharge, or of no discharge at all. On examining the case, one frequently finds a dark brown crust covering the perforation, and extending out for a considerable distance on the posterior wall of the canal. These cases are the most dangerous with which we have to deal. The spreading inward of the epithelium constitutes a cholesteatomatous condition in the tympanic vault. These cases are prone to develop intracranial symptoms, and should not be accepted for general military service unless reconstruction is made. (5) The next variety of perforation is complete destruction of the drum membrane, with sinuses leading in front and behind the short process of the malleus into the tympanic vault. If these cases are dry, they should be accepted for general military service, provided the hearing is adequate to pass the test. With even a slight discharge, they should be rejected for general military service unless reconstruction is permitted. In these cases the internal tympanic wall is almost always dermatized, and, if the ear is dry, they represent cases of spontaneous cure. (6) Another variety which presents itself is a case in which we have a small perforation through the membrana flaccida without the presence of granulation tissue. This condition is always indicative of intratympanic caries, and such a registrant should not be accepted for military service without reconstruction. This applies to all cases whether the discharge is constant, intermittent, profuse or scanty. In other words, this condition is an exceedingly dangerous one, and one exceedingly liable to be followed by intracranial complications.

H. Bourgeois and M. Sourdille,²⁰ in an article on "War Otitis and War Deafness," offer, under the title of "Transmastoid Atticotomy," an operation for suppuration with perforation in Schrapnell's membrane designed to take the place of the usual radical mastoid operation. The radical mastoid has a disadvantage in that the epidermis that covers the new mastoid cavity is fragile and ulcerates easily. In spite of the somewhat brilliant results as to hearing reported by many operators, the general consensus of opinion seems to be that there is considerable danger of injury to the hearing.

Heath, Bondy, Siebenmann and others have endeavored to save the drum and ossicular chain at the same time that they endeavored to bring about a cure of the suppuration. The results claimed by Heath were not obtained by other writers and his technic has rather fallen into disuse. Recent literature shows an attempt on the part of many operators to revive or modify these various procedures.

²⁰ Medical and Surgical Therapy, New York and London, 1918.

Sourdille describes his operation as follows:

1. The opening of the antrum is performed in the same way as in the complete operation; care must be taken to detach the membranous meatus gently and to avoid wounding the tympanic membrane.

2. The opening of the external attic is a delicate part of the operation; it consists in removing, without touching the ossicles, the external wall of the attic, formed not only by the wall proper of the attic, but also by the roof of the external auditory meatus. The extent of the bone to be removed, from the meatus to the attic, is at least 15 mm., with a vertical thickness of from 5 to 6 mm.; its ablation must be methodical if the success of the operation is not to be compromised.

The technic consists of four stages:

First Stage. Incomplete resection of the roof of the meatus, without resorting to heavy blows; the gouge must be driven fairly rapidly. It transforms the osseous wall, thick and oblique, into a well-defined, thin, level plate, on which the fine gouge can work with precision and without danger of slipping. Exposure of the suprajacent dura mater must be avoided and to this end the direction of the roof of the antrum and of the aditus must be followed, the level of which is indicated by the orifice of the mastoid trepanation.

Second Stage. Superior opening of the attic. This is performed by degrees from behind forward, with a fine gouge, 3 mm. in size, which removes the whole of the superior part of the plate just made; the bone is spongy and is easily cut by gentle blows, for at all costs a slip into the deep part must be avoided. The gouge is held all the time above the ossicles which are protected by the osseous peritympanic ring, the next part to be resected.

Third Stage. Breaking down of the bridge. This is not carried out in this instance as in the complete mastoid operation, from its posterior part to the level of the incus; the bone is friable, and the gouge, by its blow, nearly always detaches a small piece of bone, which driven inward risks dislocation of the incus. It is at its anterior part, in front of the head of the malleus, that the gouge cuts it through.

Fourth Stage. Resection of the tympanic ring. The part situated in front of the ossicles is first cut away, then the posterior part; during this stage the gouge should be held as nearly as possible parallel to the ossicles.

3. Treatment of the soft parts. The attic is completely opened; by means of syringing with Hartmann's camula the cholesteatomatous debris which blocks it up is removed. The ossicles are sometimes hidden under the granulations which cover them; we must not be insistent in clearing them; this can be done during the postoperative treatment. The operation is concluded by cleaning up the mastoid wound and carrying out a large "plastic" of the meatus with an inferior flap, as in the complete mastoid operation, with suture of the retro-auricular wound. Finally, the operation cavity is plugged with iodoform gauze.

Postoperative Treatment. This is of primary importance for the success of the procedure. Regular epidermization of the operation cavity and cicatrization of the attic and ossicles must be assured. The

dressing should be repeated every day. In the first place, the operation cavity, and, above all, the attic should be syringed out with Dakin's liquid or Labarraque's solution well diluted with sterilized water (2 per cent.) by means of Hartmann's cannula, followed by careful drying and cauterization, when necessary, of the granulations on the ossicle with a solution of chromic acid (1 in 30), or chloride of zinc (1 to 20), and finally dressed with small strips of iodoform gauze, as in a radical mastoid operation. After a week, plain sterile gauze alone should be used for the dressing. The duration of the treatment is very much the same as for the complete mastoid operation, from fifty to seventy days. The hearing reappears suddenly after the first dressing; it decreases on the following days, and then it increases progressively after cicatrization and absorption of the connective tissue which may have developed about the ossicles.

Results. In the last patient operated on, after fourteen years of supuration in the attic with cholesteatoma, complete cicatrization took place by the sixty-eighth day after the operation. Hearing for the low voice increased from 0 m. 80 before the operation to 8 meters.

Berggren²¹ has used the Carel-Dakin treatment in the *after-treatment of acute mastoids*, secondary suture being made from three to eleven days afterward. The fluid must come in direct contact with the walls of the wound cavity. The bacterial content of the wound is to be determined before suturing, and when this is from 0-1 the conditions are favorable for suturing. In acute and chronic otitis media, the solution was without result.

Guisez²² recommends Vincent's powder for local use after operations on the nasal sinuses or mastoid, or in traumatic injuries. This consists of calcium hyperchlorite 1 part, well dried boric acid 9 parts. It is used with a powder blower whenever the secretions are malodorous. Do not continue too long, as it may produce excessive granulations. Omit as soon as the wound is dry.

Suppurative Disease of Ear. Frank Allport²³ suggests the use of "Trichloracetic Acid for Persistent Openings in the Drum Following the Incision for Otitis Media." An application, limited so far as possible to the edges of the perforation, is made at intervals of a week, the opening being protected by a small cone of tightly twisted cotton. This treatment met with success after iodine, nitrate of silver, boric acid, artificial drum soaked in alcohol and the like had been tried in vain; 10 per cent. cocaine preceded the application. By wrapping a small bit of cotton tightly around the tip of an applicator slightly moistened and dipping in a bottle of trichloracetic crystals, sufficient acid is taken up by the applicator, which should be applied under direct vision.

A case of "Death from Aneurysm of the Carotid Jugular, Secondary to Self-inflicted Otitic Lesion," is reported by Pusateri.²⁴ The patient injected nitric acid into auditory canal to avoid draft. Fever, vomiting,

²¹ Nordisk Tidskrift of Oto-Rhino-Laryngol, 1917, Band ii, No. 4.

²² Paris médicale, September 1, 1917.

²³ Annals of Otology, 1917, p. 617.

²⁴ Head Surgery, October, 1918.

vertigo, headache and acute pain in the mastoid region followed, eighteen days later there was paralysis of the facial nerve, still later blood from nose and throat. Exenteration of cavum tympani and removal of numerous granulation was performed, but the discharge continued. Patient almost recovered when venous otorrhagia returned, fever and profuse bleeding from the nose, loss of consciousness, and death. At postmortem, rupture of two aneurysms of the jugular vein and internal carotid were found.

OTITIC MENINGITIS. Smith²⁵ finds otitic meningitis to present two formidable conditions which must be met and successfully combated. These are intracranial pressure and bacterial invasion of the blood. It is sometimes impossible to anticipate the development of meningitis. In 3 cases the patients became unconscious within twenty-four hours after the initial ear lesion and never recovered consciousness, succumbing in from twenty-four to forty-eight hours. The spinal fluid was under greatly increased pressure, and there was marked retraction of the head. He recommends more frequent examination of the spinal fluid, even though meningitis be not suspected. In the presence of severe headaches, with a rise in temperature, in a case of suppurative ear disease, it is safe and reasonable to suspect the presence of meningitis. If, in addition, an examination of the cerebrospinal fluid shows increased pressure, bacteria, a high cell count, absence of sugar, presence of serum globulins and a definite increase in the polynuclear percentage, the diagnosis of meningitis would be unqualifiedly established, and would call for immediate surgical intervention.

Ruyter²⁶ urges that every case of fracture of the base of the skull be examined by an aurist and under no pretext should either the ear or the nose be irrigated. In each case of meningitis following traumatism where the point of departure of the infection is not known or clearly demonstrated by autopsy, it is necessary to make a histological examination of the auditory apparatus. Fracture of the temporal bone as far as the cranial cavity has no great importance as a cause of slow (delayed) meningitis. The infection follows the same course ordinarily as in a case of meningitis following labyrinthitis. A case is reported in which, six months after the injury, the patient was taken with violent headache, rise of temperature, impaired vision, retention of urine, delirium, Babinski's sign, exaggeration of tendon reflex with no paralysis. Lumbar puncture showed pus-like fluid with staphylococci. Death occurred one month later. Autopsy, suppurative meningitis, fracture detaching part of promontory from labyrinth continuing to round or oval window making a communication between middle and internal ear. Operation is not advisable for fracture of petrous bone but is indicated if accompanied by labyrinthitis.

TUBERCULAR MENINGITIS. Eagleton²⁷ has found tubercular meningitis to be very deceptive. There may be no suggestive appearances,

²⁵ Transactions of the American Otological Society, 1917.

²⁶ *Revue de Laryngologie*, June 30, 1918.

²⁷ Transactions of the American Laryngological, Rhinological and Otological Society, 1917.

but if the para-arachnoid is taken up and held before a light, numerous tubercular spots will be seen. Many deaths from tubercular meningitis have not been recognized, even at postmortem, because of the failure to recognize that miliary tubercles may be scattered through the pia, and not recognized by the naked eye. If the part is torn loose and held up to the light, it is easy to see the little spots. These occur generally around the base. There is another pathological condition that occurs in life but is not found at death. In a man that has been suffering from mental disturbances if a large bone-flap over his skull is made during life, it will be found that the pia arachnoid is full of a little fluid looking like scales of fish. This can be evacuated by touching with a needle, and a large amount of the fluid comes out. But after the man dies, nothing is to be found at postmortem. The fluid has gone back into the lymphatic space and the appearances are normal.

Sinus Thrombosis. Phillips,²⁸ in some remarks in the discussion on the report of a case of "Spontaneous Recovery of Lateral Thrombosis" made by MacKinney, of Memphis, said that his attention had been called to spontaneous recovery of lateral sinus thrombosis during a long period of teaching operative surgery of the mastoid on the cadaver. During this time he had repeatedly discovered obliterated lateral sinuses even in cases that had died from other diseases. But there was invariably evidence of purulent disease of the middle ear. From this he had become convinced that there was a certain proportion of cases in which spontaneous recovery from lateral sinus thrombosis took place and that in every case the sinus was obliterated. His clinical experience had also borne this out and had convinced him that many cases of lateral sinus thrombosis, especially of typical types, recovered spontaneously.

Pietri²⁹ recognizes three types of lateral sinus infection, (1) a periphlebitis, (2) a parietal phlebitis, and (3) an obliterating thrombophlebitis. He reports illustrative cases. Periphlebitis may be confused with an acute exacerbation of chronic otitis media, or an acute otitis following scarlet fever or rubella. There are signs and symptoms of an acute infection, with prostration and sepsis, mastoid tenderness, and danger of parietal phlebitis and metastatic abscesses.

In parietal thrombophlebitis there is a sudden appearance of fever, rapid increase in the severity of the symptoms, resembling true septi-cemia, as in acute osteomyelitis. The patient has a typical typhoid appearance. Pyemia progresses to a terminal meningitis, with cerebral edema and death, which comes before any thrombosis has time to break up into emboli.

OBLITERATING PHLEBITIS develops more slowly, and the patient between attacks of chills and fever has been up and around, and the condition of thrombosis is only found at autopsy. The diagnosis is difficult, and ordinary clinical signs are as obscure as in cases of pressure from extradural abscess.

SURGICAL TREATMENT consists in opening the mastoid antrum. The discharge may be small or large, often osteomyelitic in character.

²⁸ Transactions of the Otolological Society, 1918.

²⁹ *Revue de Laryngologie*, August 15, 1918, xxxi.

The covering over the sinus is often destroyed, the latter usually does not pulsate and is compressible. In these cases do as little as possible; clean out, wash with 10 per cent. zinc chloride and close the wound with a drain in the antrum. If the canal and drain both show pus, the stitches can be removed and any focus of infection attacked and treated with Dakin's solution. Sluggish healing can be accelerated with $\frac{1.8}{1000}$ magnesium chloride. There is a possible danger of causing perichondritis.

Sinus Treatment. Persistent discharge from the canal is best treated by the instillation of a few drops of alcohol at 90°, saturated with boric acid. With the onset of signs of septicemia or pyemia, make a local abscess and get ready to start intravenous injections (see below) of silver-camphor. Watch the temperature. Pulsations of the sinus are abnormal and indicate infection. There is no pulsation in the obliterative type because of clot formation. In the first case reported there was no pulsation until periphlebitis, chills and fever came on, showing absorption. These disappeared as the temperature went down. This idea is very important and not sufficiently recognized by most men. Change in the color of the sinus is also important. The lumen may be so diminished as to give nothing on puncture, which, however, is of value only if positive, and a negative does not prove obliteration.

The question of opening the sinus is hard to decide. If there is definite evidence of thrombosis, open the sinus and remove the clot only when it is not organized or has supplicated, since removal of healthy, organized clot will certainly be followed by infection, despite the iodoform gauze. If the clot is septic, it must be removed, and the hemorrhage checked with a tampon. Any healthy clot should be left to act as a protection. Pack the tampon in zigzag folds to avoid starting up bleeding at the time of dressings. Watch for meningitis, cerebral abscess and other new foci of infection.

As to tying the jugular, an embolus from the thrombosis breaking up is pretty rare; they are not easily washed into the blood stream and a clot is just as liable to form at the ligature as in the sinus. Collateral circulation tends to defeat the aim of ligation. Danger of air embolus from opening the sinus is negligible. Secondary hemorrhages are readily controlled. Statistics show as many cures without ligation. Ligation may cause such cerebral congestion as edema, hemorrhage and adjacent thrombosis. Ligation is necessary when the jugular vein itself participates in the infection, and it may be necessary to resect it.

MEDICAL TREATMENT. The author produces a localized abscess on the theory that absorption from a diseased sinus may lead to a condition of septicemia or pyemia, with organisms in the blood stream, as in typhoid.

Technic. One cubic centimeter of essence of turpentine is injected subcutaneously into the outer surface of the thigh. If no reaction in twelve to twenty-four hours, inject again. Cure rarely follows in those cases which do not show a local abscess at the point of injection of the turpentine. Prognosis is good if an abscess appears rapidly. Usually the spot becomes inflamed, fluctuation appears and the general condition improves. The abscess should not be opened until convalescence

begins, say at the end of twelve or fifteen days. The injection must be made with absolute asepsis, else trouble will result. The pus obtained should be sterile, owing to the action of the turpentine, but the abscess serves as a point of attraction to pus and organisms, which are killed by the turpentine. This can be proved by using something besides turpentine. Poisons, toxins and cellular debris are all attracted to the abscess, and metastatic abscesses prevented. A case is cited illustrating the beneficial effects of two such abscesses in a case of lateral sinus phlebitis with a metastatic abscess in the popliteal space. Intravenous injection of electragol is also used.

The foregoing method of treating sinus thrombosis is given as showing the difference between the American and French practice. In the presence of septicemic temperature, with chills and signs suggesting sinus thrombosis, the reviewer believes the American practice of tying off the jugular and clearing out the sinus is the safer method. The formation of localized abscesses elsewhere does not commend itself to his judgment, though he is not questioning the validity of the author's statements.

Facial Paralysis. Hall³⁰ reports 2 cases of *traumatic facial paralysis*. This paralysis is rare, its nature and location hard to determine beyond the point that it is of the peripheral type. Among the accidental causes are obstetrical paralysis from forceps; direct or indirect fracture of both temporal bones from blows, or forceful compression. The paralysis comes on in the latter instantly, due to section of the nerve, or intra-Fallopian hemorrhage, or, after a few days, resulting from pressure from a hematoma, or periostitis in company with a middle-ear suppuration following a ruptured drum. Rarely, meningeal hemorrhage is a cause. A concussion from a near explosion may be severe enough to cause a hemorrhagic paralysis.

The *symptoms* are those of a double hemiplegia of the usual type, somewhat more pronounced on one side. The expression is that of a statue or masque, and reveals no mental activity. The forehead is smooth, without wrinkles; the tears flow out between half-opened lids, and saliva dribbles from half-opened lips. The eyes are staring; Bell's sign and Negro's sign are present. MacCarthy's reflex is gone on both sides. Smiling, whistling and the pronunciation of many sounds are impossible. The tongue and mastication movements are somewhat hindered. The palate is intact, but taste in the anterior two-thirds of the tongue is gone and hyperacuity is present, showing the tympanic branch and the chorda tympani to be involved. Electrically, there are double reactions of degeneration. The diplegia is more pronounced in the inferior than superior branches of the nerve. An associated involvement of the eighth is not uncommon, resulting in marked deafness.

In Rose's cephalic tetanus, following wounds of the cranium, one may see a diplegia of toxic origin, and the trismus, painful contractures and deglutitory difficulties must be the indication for immediate serum injection.

Prognosis is doubtful and surgical intervention for nerve anastomosis or plastic on the soft parts of the face may be resorted to.

³⁰ Revue de Laryngologie, January 31, 1918.

Treatment is the same as for hemiplegia of the facial nerve—psychotherapeutic, the galvanic and faradic current.

Army Service. Aviation. Scruton³¹ endeavors to counteract the impression, now more or less general, that it is almost impossible to pass the physical examination established by the Aviation Section of the Signal Corps, unless one is a sort of superman. Many men come to the examinations primed with false notions as to what they are going to experience in the way of physical tests. The mallet test and needle test seem to be dreaded, probably due to exaggerated accounts of disqualified candidates and their friends.

In the mallet test, the candidate is supposed to be led into a room alone with two examiners. He is seated at ease, while an examiner holding a stop-watch engages him in conversation. The second examiner is behind the chair, and cannot be observed. At the proper moment, that is, when the candidate is thoroughly calmed by conversation, he is tapped on the head with a mallet at a non-vital spot. If he recovers consciousness in twenty seconds, he is normal.

In the pistol and needle test, the candidate is again seated at ease. He holds a needle between his thumb and forefinger, the point being against the forefinger, and the head against the thumb. While he is engaged in conversation concerning his knowledge of pastoral pursuits, a pistol is suddenly discharged. If the needle pricks his finger, and draws blood, he is disqualified as nervously unfit. Of 1752 men examined, 1132 were passed and 620 rejected. Of 1364 fliers examined, 850 were accepted and 514 rejected.

The rotation tests are the ones most feared by the candidate, probably due to the large number of published magazine and newspaper articles written as news items for public consumption, but out of 1364 men, only 21 were disqualified for failing to respond correctly to the rotation test. If these tests show normal responses, they indicate not only normal labyrinth, but normal eighth nerves and normal vestibular pathways. When these tests are carried through, according to the prescribed directions, the candidates rarely experience any unpleasant effect. It is necessary that the candidate maintain a correct position in the chair, that he be rotated exactly 10 times in ten seconds and that the rotation be stopped with a considerable jolt.

Vertigo. Vertigo is now recognized as a symptom which is the result of some disturbance of the vestibular nerve, either in its peripheral distribution in the labyrinth or in the central course of the nerve in the brain. The most frequent cause of primary involvement of the labyrinth, producing nerve deafness as well as vertigo, is a degenerative process, the result of syphilis or infectious fevers. Shambaugh³² finds the most frequent cause of vertigo is an association with the chronic degenerative process, developing independent of syphilis, or the infectious fevers, and involving, as a rule, the peripheral neurons of both cochlear and vestibular nerves. When the cochlear nerve is affected,

³¹ *Annals of Otology*, June, 1918.

³² *Iowa State Medical Association*, August 15, 1917; *Annals of Otology*, September, 1917.

there is a continuous high-pitched tinnitus, and defective hearing at the upper end of the tone scale. Involvement of the vestibular nerve may be associated with attacks of vertigo, showing an increase in the degenerative process. Hemorrhage of the labyrinth is less common than was formerly supposed. Neuritis of the eighth nerve may occur from overdoses of drugs, such as quinine, tobacco and alcohol, with many, Menière's syndrome. A chronic focus of infection, such as chronic infection of the faucial tonsil, may produce neuritis of the eighth nerve. Whenever degeneration of the eighth nerve develops, quite independent of any other manifestation of systemic infection, a possible focal origin should not be overlooked, for it is not an infrequent phenomena to observe a single nerve the seat of persistent neuritis from focal infection.

Galvanic Test for Nystagmus. Heitger³³ finds the galvanic test for nystagmus requires an accurate milliamperemeter with a pole changer and an assistant to control the current and its polarity, the latter being unknown to the examiner until he sees the nystagmus. The electrode should not be placed on the mastoid, as described by some writers, but rather against the tragus, which is forced against the external auditory meatus, with the ball of cotton wound around the well-moistened electrode. The nystagmus developed by the galvanic current is quite different from that in the turning and caloric tests, its amplitude being quite small. It is a slight rotary twitch, which must be observed very closely to catch its first development. The galvanic technic deserves more than has been accorded it, and everything depends on accuracy in its application, if results are to be obtained.

G. W. MacKenzie³⁴ considers the galvanic test more reliable than the caloric, since in this test each ear is tested separately.

General Deafness. Emerson³⁵ regards chronic middle ear deafness as always due to some form of low-grade infection from one or more primary foci. Nerve deafness in non-specific cases is due to toxemia from some definite focus. Inflation in chronic cases is unscientific and harmful as a routine. When the tube is open, it does no good. When the tube is not open, it does not remove the cause. Nasal obstructions are of moment only when interfering with normal drainage and should be cared for. All possible foci, whether in the sinuses, tonsils, mandible, or epipharynx are sequelae of these infections following la grippe leaving a streptococic foci, and are factors in the progress of progressive otitis media. Constitutional diseases have but little effect except to lower the patient's resistance, and make him more susceptible to exacerbations of his localized focus or foci.

Medicated Eustachian Bougies. All otologists have felt the necessity of applying medicaments to the Eustachian tubes, but most of the suggestions and apparatus devised have, after a short time, been abandoned; at least that has been the reviewer's experience. Hurd³⁶ has suggested a method which obviates the difficulty with the aqueous solution on

³³ Journal of the Indiana State Medical Association, April, 1918.

³⁴ Annals of Otology, September, 1917.

³⁵ Boston Medical and Surgical Journal, October 25, 1917.

³⁶ Laryngoscope, December, 1917.

cotton, or the wire bougies carried through the catheter, which has the disadvantage of squeezing off the fluid and the difficulty of getting the right quantity of cotton to go through the catheter. Celluloid bougies are used, which are coated with silver nitrate, using gum acacia as a base. In a narrow test-tube, make a saturated solution of gum acacia in a water-bath, then add the silver nitrate solution, making the solution from 1 per cent. to 10 per cent. strength of silver, as desired. The bougie is dipped about one and one-half inches into this solution, and when the bougie has a uniform coating, it is placed to dry; then it is usually given a second coating. When dry, the gum acacia and silver coating look and feel like varnish to the dry fingers. The silvered bougies can be made up in quantities, and when kept dry, will last fairly well for a week or more. The one disadvantage of using bougies several days old is, however, that the silver nitrate will gradually oxidize, so that the coated bougies, a week or more old, may have lost half of their silver nitrate percentage. A plain gum elastic or celluloid bougie, of the proper size, is passed through the tube to make sure of the position of the catheter, the size of the bougie the tube will admit, and also to dilate the tube, then the plain bougie is withdrawn, and the coated bougie can be readily passed as far as desired and remain there about two minutes to allow the moisture of the membrane to dissolve the gum and deposit the silver where desired, knowing that a definite percentage of the silver nitrate has been deposited. When the bougie is withdrawn, the gum coating will be entirely gone or only a little stickiness will be felt.

Results. One or 4 per cent. is usually strong enough to contract the membrane; if not, the strength can be increased up to 10 per cent. The weaker silver nitrate percentages produce no discomfort, but sometimes the stronger percentages will give annoyance and cause some pain, referred to the ear, similar to the discomfort produced in the nose by 10 per cent. silver nitrate.

Artificial Ear Drums. Various types of artificial drums, mostly modeled after the Toynbee pattern, are familiar to all readers of newspaper advertisements. These usually fail to do much good, and, when wholly in lay hands, both as to when and the how of using them, may do much harm. Yet there remains a class of cases where such a device may do much good and where the aurist should be the person to prescribe them, and introduce and remove them.

Baum³⁷ offers an artificial ear drum made of oiled silk and adapted to insertion into the external auditory canal in such a manner as to be brought in a smooth and correct coaptation with membrana tympani without causing irritation or pain. It is suspended perpendicularly concaved, and retained in this position by four roll-like folds in continuity with multiple cornicopial or cone-shaped sound accumulators, in which the outer or distal expanded openings are largest, gradually diminishing their lumen toward their approximal ends with smaller openings into an expanded or ampulla-like cavity in front of the artificial drum. The

³⁷ Laryngoscope, November, 1917.

continuation of the outer folds of the accumulators expands outwardly with another roll-like fold continuous with the perpendicular circular surface diaphragm or artificial drums, approximating the natural drum or membrana tympani. The outer roll-like surfaces of the megaphone appendages afford a cushion-like contact with the canal walls, conforming with, and permitting an easy and flexible support to the perpendicular surface diaphragm or artificial drum. The formation of these roll-like appendages is such as to afford ample intervening space for ventilation and drainage, and for sustaining the membrana tympani while the artificial drum holds it in position.



Fig. 18

Fig. 18 designates a blank cut from oiled silk which is smooth, elastic, pliable and flexible. The outer edge forms a plurality of rounded surfaces (2), which in the form are four in number. The body portion is provided with radial slits or cuts (3, 4, 5, 6), which communicate with the circular cuts (7, 8, 9, 10), respectively. The circular cuts are, preferably, substantially one-eighth of the circle. The blank is then folded into position seen in Fig. 2 and 3 and the juxtaposed edges are cemented as indicated at 11. This forms at one end a flexible disk at 12 (Fig. 4). In the form illustrated these are four in number. These appendages are in continuity with the disk and are sustained by the four pillar-like supports (14) (see Figs. 3 and 4) and four openings (15, Fig. 4) are provided in proximity to the disk (12). Fig. 5 designates the inserter, which is provided with four slits (17) at its forward end, which are

adapted to engage the pillar supports (14, Fig. 2 and 3) in order to insert the artificial drum in place.

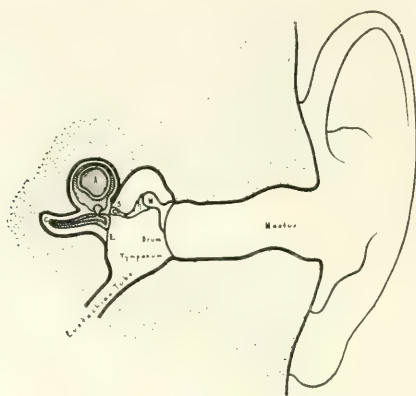


FIG. 19

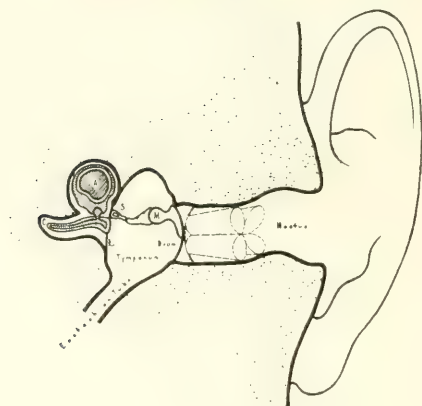


FIG. 20

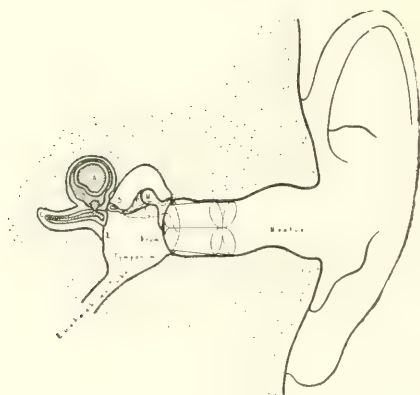


FIG. 21

Fig. 19 illustrates in this instance, for comparative methods, a normal ear showing the cup-in shape of the drum and the proper angle and alignment of the ossicles. This cup-in shape is adapted to the accumulation and concentration of sound. The angle at which the ossicles are suspended allows vibration to be transmitted to the inner drum or fenestra ovalis.

Fig. 20 shows, in contrast to Fig. 19, the distended drum—the effects of chronic insufflation, politzerization, or too forcibly blowing the nose, forcing air into the middle-ear cavity, distending the drum and throwing the little bones out of alignment, and causing a locking of them also.

Fig. 21 illustrates the correction. This is brought about by the presence in the ear of the phones. The cup-in shape of the artificial drums against the natural drum raises the little bones in turn and reestablishes the cup-in shape of the natural drums. The dotted line illustrates the distorted condition shown in Fig. 20.

Retaining the device in position acts as a delicate splint, enabling the membrana tympani, ossicles and ligaments to regain their tonicity.

In conjunction with this device, the protector illustrated on page 279 may be worn to prevent the entrance of injurious vibrations from concussions and loud noises.

While the foregoing statements savor somewhat of the natural enthusiasm of the inventor, the device seems to the reviewer a rational one and worthy the attention of the physician who has cases of deafness to treat. The device is also used in certain cases of perforation since, even if there is discharge, the device offers no obstacle to the outward passage of the discharge, and in many cases acts as a substitute for the perforated drum.

Foreign Bodies in the Auditory Canal. All kinds of foreign bodies, both living and dead, have been reported as found in the external auditory canal. The following case, reported by Coussieu,³⁸ is probably unique in medical literature. He was called to see a four-year-old girl who complained of severe pain in the right ear, which had begun seven hours previously. Previous health good. All treatment by the family to relieve the pain had failed, which was paroxysmal in character. Expecting to find an acute otitis media, the author was surprised to find only slight bulging and reddening in the posterior half of the drum. The mastoid was not tender. There was no fever and the nasopharynx was negative. He prescribed glycerine-phenol, warm, in the canal, hot applications and ordered the child to return the next day if no better. Twenty-four hours later the child returned, having suffered acutely since the previous visit. The drum was redder and more bulging. Under an anesthetic, an incision was made, from which no pus escaped. The next day the pain was more severe, with attacks of syncope in the night, violent nystagmic crises and general convulsions. On examining the ear, he found the canal obstructed by a vermiform object, similar to a tube of paste. Seizing it with forceps he drew out a living *ascaris lumbricoides* 15 c.c. in length, of the male sex. The child immediately

³⁸ *Revue de Laryngologie*, August 15, 1918.

fell asleep for the greater part of the day. The drum is now normal as well as the hearing. There was no history of passing any worms per rectum. Clearly, the animal passed up the Eustachian tube, and the pain began as soon as it reached the drum and lasted until the escape through the incision.

RHINOLOGY AND LARYNGOLOGY.

Nose Transplants. Carter,³⁹ who has successfully used bone transplants for several years, does not regard infection in the wound as necessarily meaning the destruction of the entire transplant. A transplant without periosteum remains alive but does not grow as vigorous as one covered with periosteum although periosteum *per se* does not reproduce bone as MacEwen has stated, and transplants in contact with live periosteum-covered bone continue to live and perform their function without regard to their change of position in the body. In carrying out this method, the wound necessarily made where the transplant is taken frequently causes more inconvenience to the patient than does the nasal wound. To avoid this, New,⁴⁰ of Rochester, has used perforated *celluloid plates*, if possible, as an implant into the tissues over the nose in a series of dogs and in 5 cases in man. The results have been so satisfactory that he regards celluloid as preferable to either cartilage or bone.

Three cases have been built up with good results, and a fluid preparation of celluloid has been used in elevating deep scars. In the experiments of dogs, the prepared celluloid was found to fill in with minute stumps of tissue which extended completely through the perforations in the implant. He, therefore, perforates the celluloid in all cases.

The technic is that in general use for this sort of work, so far as the wound and the operation on the nose are concerned. The celluloid is used in pieces varying from 2 to 4 mm. in thickness. They are boiled ten minutes for sterilization and then curved into the proper shape in hot water and held in the required position in the hot water until cooling takes place. The celluloid is carried quite to the tip of the nose, and the wound is closed with horse-hair sutures and sealed with compound tincture of benzoin. A thin copper splint is applied externally and held in place by adhesive plaster during the healing of the skin wound. In 5 cases in man, the wound healed primarily with practically no reaction.

This method would seem to be worthy of further trial, since celluloid is readily obtainable and is easily worked. It has also the advantage that it can be readily trimmed or curved when put in hot water, causes no reaction and remains stiff even when trimmed quite thin.

New Instruments. Otto J. Stein⁴¹ shows a nasal splint that a general medical man may use as well as a rhinologist. It is of value in holding

³⁹ Annals of Surgery, 1917, vol. lxvi, p. 162.

⁴⁰ Journal of the American Medical Association, April 6, 1918, p. 988.

⁴¹ Journal of the American Medical Association, January 26, 1918.

cotton, gauze or ointment in contact with the septum, or in the treatment of fracture of the septums, epistaxis, ulceration, etc. It is made of two parts making it easy of introduction and adjustable to any degree of pressure, and, when properly placed, allows free breathing.

Hemorrhage from the Nose. For annoying *septal hemorrhage* in children and adults, Leshure⁴² advises submucous elevation of the septum when ordinary methods, as the cautery and astringents, fail. Elevate as for a submucous operation backward for one inch, and down to the floor of the nose. Compress the elevated membrane between the blades of a special forceps, replace the flap and pack in the usual manner from twelve to twenty-four hours.

Corwin⁴³ says the word bleeder, or hemophilic, is used in a more or less loose way by many physicians to describe the episode of vicious epistaxis, or severe, possibly fatal, postoperative hemorrhage marked by prolonged bleeding time and delayed coagulation, but without adequate grounds for such a diagnosis. Many hemorrhages, purpuric in character, are placed in this class, but wrongly so. The real bleeder has a definite heredity through unaffected females, prolonged bleeding time, markedly diminished coagulability, a normal blood picture, except leukopenia, blood platelets not diminished, and has its origin in early youth.

Blood clotting is accelerated by raising the temperature and retarded by lowering it. Ice-bags following tonsillectomy are illogical, but *hot pledgets*, not too hot, inserted directly into the wound, will act as magically to check hemorrhage in the throat as in other surgical fields. Blood will clot better under ether anesthesia than under carbon dioxide and oxygen anesthesia. *Calcium salts* administered internally have not stood up to theory, but, applied to the wound upon pledgets soaked in 1 or 2 per cent. solution, calcium chloride is of distinct benefit in checking hemorrhage, but the most useful of all means to overcome pathological hemorrhage is *blood serum*, or *whole blood*, introduced into the circulation.

Ozena. Roy⁴⁴ has studied ozena among various races, especially the Negro and Mongolian, for many years. In the Mongolian, the discharge is mucopurulent, with crusty deposit and odor. They also have a tendency to atrophy of the anterior third of the inferior turbinate without any pathological symptoms. He regards ozena as an infectious disease found in all races, less frequent among the blacks than whites, and most prevalent in the yellow race who have a tendency to deviations of the septum. The Blacks of the interior are not yet affected. The infection theory is the only satisfactory one. In his opinion the coccobacillus of Perez is really the specific vehicle of the infection, since laboratory experiments confirm and prove the theory.

Duverger⁴⁵ postulates that ozena is not a specific bacteriological

⁴² American Journal of Surgery, 1917, vol. xxxi, p. 75.

⁴³ Annals of Otolaryngology, September, 1917.

⁴⁴ Journal of Laryngology, September, 1917.

⁴⁵ Revue de laryngologie, d'otologie et de rhinologie, January 15, 1918.

disease but a local trophic affection easily cured. His opinions are based on studies made among the Arabs.

The old idea of ozena being spread by contagion has no foundation, so far as work among Arabs goes. Laboratory proof of any spreading by contagion is lacking, and clinical work shows ozena to be a local, trophic condition, easily curable, depending on the general health and the condition of nasal respiratory function. After certain operations (polyps, spurs, hypertrophied turbinates), an "artificial coryza," simulating true ozena, comes on too quickly to admit of bacterial explanation, being rather the result of operative trauma in hypersecretive persons, who, having never breathed through their noses, do so no better after operation because they do not know how to breathe; the traumatized surface becomes the seat of stagnant secretions no longer drained externally, becoming secondarily infected and producing typical foul and crusted accumulations. Cure results from detachment of the crusts and reëducation in proper breathing through the nose.

Duverger does not allow a drop of water in the nose, never uses any powder or insufflation apparatus to detach crusts, but, instead, uses menthol or eucalyptol oil sprays to facilitate dislodging crusts. These treatments are disagreeable to the patient for about a week, then they are more comfortable. Crusts come off in from fourteen to twenty days, and the odor is gone in two months. The atrophic tissues heal and a cure is attained. In these cases the most important thing is enforced nasal breathing at night and during the entire day, the former being enforced by the use of a mask, no matter how inconvenient. The general health is to be promoted by an abundance of fresh air. When these patients are discharged, they are told to report occasionally continuing their exercises. Special difficulty is encountered by persons with short lips for whom it is a very great effort to keep the mouth closed. Also the apparent abolition of a normal mouth-closing reflex, dependent on a current of nasal air and controlling the tone of the mouth-closing muscles renders the execution of the treatment difficult. Duverger recommends all cases for commitment in sanatoria where they may have more rigorous oversight in enforcing their treatment, preferably situated in the country; this is with a view to building up the general health, as in tuberculosis.

The reviewer has had a large experience with ozena covering many years and cannot but regard the foregoing as an unduly optimistic point of view. It is based on only 6 cases seen in Egypt. Ozena has been treated by both wet and dry methods for many years, and as yet is an unsolved problem. The method is given here that it, along with the vaccine therapy, may have further trial. At present, the advantage of the argument is with the advocates of the bacterial theory of etiology and resultant therapy.

Septum. SUBMUCOUS RESECTION. Vattier⁴⁶ finds many failures after submucous resection of the septum. These are usually due to high

⁴⁶ Laryngoscope, March, 1918.

deviation, hyperplastic ethmoiditis, polypoid degeneration and chronic inflammatory conditions of the mucous membrane and ethmoid cells. Unless these are properly corrected at the time of the operation, the condition will not be relieved, but in a great many cases will be aggravated.

Recalling the anatomical relation, we find that the inferior border of the middle turbinate bisects the nasal cavity, the lower border of which is the floor of the nose; the superior the cribriform plate. Remembering this, one may have greater latitude in his operative procedures.

Detached spicules of bone or cartilage lodged crosswise between the mucous membrane frequently give greater deformity with corresponding symptoms than the original condition from which the patient suffered.

DEFLECTED. MacFarlane⁴⁷ advises against operation for deflecting septa in the very young, but says that correction by pressing the septum over with the index finger works admirably, with permanent results. A splint is worn on the side of the deflection and pressure with the finger applied twice weekly. This causes pain, but he says the results justify it.

This is not in accordance with the experience of the reviewer who finds that children bear nasal splints very badly. It is much better to give ether and fracture or displace the cartilage, putting in the splint at the time of the operation and leaving until healing. This splint does not cause pain and when the child is older the regular submucous operation can be performed.

Headache of Nasal Origin. Sluder⁴⁸ describes a class of headaches which he calls vacuum frontal headaches due to unfavorable anatomical settings, such as narrow noses, plus hyperplastic changes in the soft parts and bone. The principal symptom is inability to use the eyes for near work on account of the headache thereby produced. There is no pus discharge and the nasal trouble is revealed by tenderness at the inner angle of the orbit at the point of attachment of the pulley of the superior oblique muscle and internal and posterior to it. This portion of the orbit is formed by the frontal sinus and is usually the thinnest portion of the sinus wall. The explanation is that secondarily to the closure of the sinus outlet there arises a congestion of the lining membrane, in which the bone takes part to a degree sufficient to render the thin wall of the sinus sensitive to even slight external pressure. The function of the superior oblique being to turn the eye downward and inward, there results for close work a tugging at this tender point, thus intensifying the dull ache caused by the simple closure of the sinus. The etiology has its source in anatomical variations and changes in the contour and relationships of the septum, and in particular its tubercle, the middle turbinate, the ethmoid, bulla, and the uncinate process, and in the size and direction of the hiatus semilunaris, and its extension to the infundibulum or what to the reviewer seems a simpler and better understood term, the frontonasal duct.

⁴⁷ Journal of Ophthalmology, Otology and Laryngology, April, 1917.

⁴⁸ Headaches of Nasal Origin, Sluder, St. Louis, 1918.

These changes anatomically group themselves into six classes: (1) Enlargement of or tilting out of line of the septal tubercle; in 38 per cent. of 451 cases this was the trouble, the turbinate being histologically normal. (2) Noses with normal clinical appearances and the middle turbinate apparently normal; on removal, the hiatus semilunaris was found narrowed or occluded, the uncinat process and bulla being in contact; there were 24 cases of this character. (3) Edema of the vault of the middle meatus and swelling of the soft tissues, which being repeated often develops polyps, with permanent increase of connective tissue in the stroma of the mucosa without any great activity or increase in the bone; there were 68 cases of this class (15 per cent.). (4) Genuine hypertrophy of the middle turbinate, 50 cases, or 11 per cent. (5) Anatomical insufficiency of the vault, with a normal middle turbinate in close contact with the external wall in a nose otherwise normal. (6) Empyema or non-suppurative coryzas which have gotten well but have left a degree of swelling sufficient to keep the frontal sinus closed and so cause enough pain to render the eyes unfit for ordinary work.

The differential diagnosis of this class of headaches is made by comparing the sensation produced by pressure with the finger on the supra-orbital nerve at its foramen with the sensation at other parts of the frontal sinus wall. If the nerve is normal and the frontal sinus closed, the orbit inferiorly and posteriorly through the supra-orbital notch becomes as sensitive, or more sensitive than the nerve itself. This sign is not found in headaches due to ethmoidal, sphenoidal, ocular, digestive, gynecological, renal, gouty, neurotic or other cause except empyema of the frontal sinus.

The *treatment* consists at first in the local application of astringents, the result of the application of which is sometimes astonishing. The author recommends 2 per cent. nitrate of silver. If this fails, the more radical treatment is the opening of the inlet of the frontal sinus which is usually accomplished by the removal of the middle turbinate, of which about two-thirds or three-fourths are removed, the inlet to the anterior labyrinth of the ethmoid being opened at the same time. This operation of opening up the infundibulum is described with cuts in *PROGRESSIVE MEDICINE*, March, 1918, pages 260, 262. Headache may also arise from closure of the anterior labyrinth of the ethmoid and is in every way similar in its mode of establishment to the frontal sinus headache just described, but it does not occur so often. The pain is at the site of the lacrimal bone and is referred from behind or between the eyes. Treatment is the same as for the frontal sinus cases.

Mouth Spray Infection. Under conditions that involve the close association of large numbers of persons, as in the great military encampments, certain modes of infection acquire a kind of exaggerated importance. The transmission of disease germs in ways that are rare in normal everyday life occurs with greater frequency and has more far-reaching consequences. Exposure to inhalation of mouth spray is one of the most serious dangers. The small droplets discharged from the mouth or nose in sneezing, coughing, laughing and loud talking float about in the air

for some time, and may be carried by currents of air to a considerable distance. There is reason to believe, from the experiments of Kohlisch⁴⁹ with tubercle bacilli, that the moist droplets which often contain a little mucus are more likely than dry dust to produce infection. Kohlisch, for instance, found in animal experiments that fifty tubercle bacilli inhaled as bacterial spray produced over twenty lung nodules, while the inhalation of over 2000 in the form of dry dust had a very irregular action and in some cases evoked no pathological change. It is a somewhat general belief that, in human tuberculosis, infectious droplets are a more frequent source of infection than dried sputum. In numerous other infections that enter by way of the respiratory tract, the inhalation of mouth spray coming from an infected person or healthy carrier seems the typical mode of infection. This is true in diseases like pneumonia, influenza and whooping-cough and probably in measles.

If it were possible, in cases of "cold" and the like in the incipient stage to make examinations, and, when necessary, to isolate the patients, the spread of mouth-spray infection might be materially checked. This measure is worthy of consideration in all conditions in which there is any definite and serious respiratory tract epidemic. There is no single and universally applicable method for preventing the transference of germs from one soldier's respiratory tract to another's, but all reasonable and persistent attempts to prevent mouth-spray infection are worth making. A person with the developed rash of measles or the skin-peeling of scarlet fever is not allowed to roam unchecked, if his condition is known; but little or no restraint is yet put, either by health authorities or by public opinion, on the wanderings of the much more dangerous person who is sneezing and coughing myriads of germs into the atmosphere. The use of masks by both patient and attendant will markedly diminish infection from these sources, and may become obligatory in the presence of any marked number of cases.

Mouth Infection. Osborne⁵⁰ considers that there is not a greater menace to health today than crowned and bridged teeth, to say nothing of imperfectly filled and dead teeth and of pyorrhea alveolaris. Infection of the tonsil and the sinuses adjacent to the nose must never be overlooked, and eradication is the only safety. From infected areas in the mouth, pathogenic organisms have been isolated, probably the most dangerous being the pneumococcus and the streptococcus viridans.

Chronic invalidism may result from mouth infections, blood-pressure may be raised, thyroid glands enlarged and serious disturbance to blood, kidneys, stomach, intestines and joints. Glycosuria can be, and true diabetes may be, caused by mouth infections, as well as ulcers of the stomach, pyelitis and appendicitis, chronic colitis and serious brain and nerve disturbance.

Pneumonia following influenza may frequently be caused by pneumococcus in the mouth. Vaccines are not promising, but in obstinate cases ought to be tried, but they should be autogenous ones. Patients should

⁴⁹ Journal of the American Medical Association, October, 1917.

⁵⁰ Ibid.

be taught that removal of infected areas does not remove the germs localized in some distant part of the body or immediately cure an inflammation caused by these germs nor restore degenerated tissue, but will remove the primary source of infection.

Kolmer and Steinfeld⁵¹ have shown in recent studies that pneumonia arises from infections from without, because of the presence of a virulent pneumococcus of the fixed serological type, contracted from persons suffering from pneumonia or convalescent from this infection. Their investigations have shown the high pneumococcidal activity of ethylhydrocuprein hydrochloride, and that quinine and urea hydrochloride and quinine bisulphate also contain considerable pneumococcidal powers.

Dilutions of ethylhydrocuprein as high as 1 to 30,000, even to 1 to 160,000, had appreciable and frequently well-defined pneumococcidal activity, while a 1 to 10,000 almost invariably disinfected the sputum containing pneumococci as determined by extraperitoneal injections with mice; such cinchonics as quinine bisulphate dilutions in sputum varying from 1 to 10,000 to 1 to 20,000 were found to possess well-defined pneumococcidal activity. For washing the mouth and gargling, use a solution of ethylhydrocuprein hydrochloride or quinine bisulphate gm. or c.c. 0.005; liquor thymolis, 5; distilled water, sufficient to make 50.

FOCAL INFECTIONS. The study of the year's literature shows the subject of focal infections to be one of paramount importance, and there are few types of chronic disease, whether asthma, bronchitis, hay fever or neuralgia, which cannot be traced to some form of focal infection, either dental, tonsillar or intestinal.

Mackenzie⁵² reports an interesting case of this type in which a neuritis of the eighth nerve, involving both branches, had its focal infection in the appendix. The patient appeared with the usual symptoms, vertigo, equilibrium disturbances and impairment of hearing, with a history of having been treated in London by inflation, with apparent improvement. The history was that of intense vertigo and nausea, with more or less pain and stiffness in the back of the neck. The attacks were frequent, as many as two in a day, and severe, and came on at any time, day or night. There was a negative Wassermann, poor memory, occasional numbness in the right side of the face, excessive fullness and bloating of stomach and bowels, and some gastro-intestinal symptoms. The family physician referred him to a neurologist, the neurologist sent him to a stomach specialist, the stomach specialist sent him to a roentgenologist. He was then sent to the dentist who found pyorrhea pockets, and some teeth were removed with apparently good results for the pyorrhea. Mackenzie treated him for his vertigo and impaired hearing, and he was not seen for some time, when it developed that a severe attack of appendicitis had set in during the interval, with gangrene and peritonitis, for which an operation had been performed by a general surgeon who removed the appendix and a large gall-stone, since which time the vertigo had disappeared, the hearing had also somewhat improved and there was no disturbance of equilibrium.

⁵¹ Journal of the American Medical Association, January 5, 1918, p. 14.

⁵² Annals of Otology, June, 1918, p. 490.

Here is a case in which the diagnosis of neuritis of the eighth nerve was undoubtedly correct, the tuning-fork findings being characteristic in every particular for a disease of the perceiving apparatus, while the presence of vertigo, with nystagmus to the unaffected side, speaks for a destructive or relatively destructive lesion of the static labyrinth, nervous vestibularis, or both combined. The practical bearing of this case is that whereas in recent years it has been the tendency, and in the main a correct one, to center all vertiginous affections in the ear, we may fall into error if we fail at the same time to consider all possible avenues of primary affections. Formerly, the stomach was considered, and still is by many, as the source of most of the vertigo, a point of view which has virtually been abandoned. It may be wise in every instance to make careful examination as to the responsibility of a chronic appendix or gall-bladder as the real offender.

Sinus Disease. Beifield⁵³ observes that the removal of the tonsils and adenoids does not always control the disease process and the source of infection may still be obscure until the accessory sinuses are found to be infected in a number of such cases. After treatment of this condition, the progress of the disease has been arrested. The frequency of sinus disease is very much greater than generally recognized, and its possibility as a focus of infection deserves more attention. It has been found to be the underlying etiological factor in a series of cases of cyclic vomiting, infectious deforming peri-arthritis, asthma, persistent cough, pyelitis, chronic digestive disturbance and poor general health. Certain signs, such as frequent symptoms of accessory sinuses with chronic purulent nasal discharge, sneezing, nervous irritability and headache, are of value in diagnosis.

SINUS DISEASE IN CHILDREN. The opinion has been more or less current that sinus disease in children was not common. Deane⁵⁴ has found this to be incorrect and believes that sinusitis in children of two years of age or more is common, and will explain many suppurative nasal discharges whose presence is not suspected, the discharge passing into the nasopharynx. Recent anatomical studies show that the sphenoid and the antra are quite definite cavities in children two or three years old. In children, the relation between adenoids and sinusitis is very intimate. He has found nephritis, cardiac lesions, pernicious vomiting, headache, asthma, arthritis, pulmonary lesions, chorea, hay fever, recurring coryza, neurotrophic disturbance, laryngitis, mild systemic sepsis and persistent fever relieved by the treatment of sinus disease. The examination of 234 children, thirteen years of age or younger, by anterior rhinoscopy and radiography, revealed chronic empyema in 34, about 15 per cent. The Wassermann test was applied to all of these with negative results. Thirteen of the 34 had a history of having had an acute infectious disease. In none could deflected septa or exostoses be considered responsible.

In *operating on the antra*, the patient lies on his back and the pharynx is kept clean with suction apparatus. The operation is never performed

⁵³ New York Medical Journal, June 29, 1918.

⁵⁴ Annals of Otology, June, 1918, p. 534.

through the canine fossa on account of the danger to unerupted teeth. The intranasal operation is performed as follows: With a pair of blunt, Knight forceps, the whole inferior turbinate is rotated outward and upward. After the rotation is complete, the interior margin of the turbinate points up and out. This gives just as good an exposure of the inferior meatus as the removal of the inferior turbinate. An opening is then made through the inferior meatal wall. Hypertrophied and necrotic areas in the antrum are curetted, the floor being especially examined for such conditions. This usually remains open long enough for healing, and if it closes it is readily reopened. When the operation is completed, the inferior turbinate is replaced and retains its original position without any apparent ill-effect from having been turned upward.

Of 7 cases in which chronic suppurative sinusitis accompanied adenoids and diseased tonsils, 5 patients were returned several weeks after removal of the tonsils and adenoids and were found to be apparently well.

Diphtheria. Diphtheria and diphtheria carriers are such a menace, not only in army camps, but in civil life as well, that the following somewhat extended review is given nearly verbatim.

McCord, Friedländer and Walker,⁵⁵ who studied diphtheria and diphtheria carriers at Camp Sherman, recommend that carriers should, as a matter of routine, be referred to a medical officer in the throat department, who should examine for any crypts or ulcers in the tonsillar or adenoid tissues and institute appropriate treatment.

A. Procedure Adopted in Line Organizations after the Diagnosis of a Case of Diphtheria. It is purposed to minimize the danger of the spread of contagion and at the same time interfere as little as possible with the organization in the performance of its duties. The latter consideration is a factor that the zealous public health worker is apt to neglect.

1. The detection of one or two cases does not call for a quarantine of the organization (company, battery, troop, detachment, etc.).

2. All known immediate contacts of the patient are segregated at once. No fixed rules can establish who contacts are. Under immediate contacts are included:

- (a) Men sleeping on either side and across from the patient. If the patient sleeps in a small room, all occupants are included.

- (b) Messmates on either side and opposite to the patient.

- (c) Fellow workers who have continually been in close contact with the patient.

- (d) Any intimate comrades with whom there has been frequent close contact.

The total number of contacts easily averages from ten to twelve.

3. Schick tests are made on all segregated contacts. Cultures are made both from the nasopharynx and from the tonsillar region of all the segregated men. Masks are worn by all men from the time of their segregation, in order that non-carriers may not be unduly exposed during the period of observation.

4. The following morning the cultures are examined. In the event

⁵⁵ Survey of Head Surgery, vol. i, No. 2.

of the detection of any carriers, they are transferred immediately to the hospital. All negatives are released for duty.

5. At the expiration of approximately thirty-six hours, the Schick reactions are observed in these men, and, if any are positive, prophylactic doses of antitoxin are administered.

6. The medical officers on duty with these troops are instructed to inspect the throats of all men of the organization for suspicious throats during the ensuing ten days.

B. Procedures Adopted in Hospital Wards in Which Cases of Diphtheria Appear, the Patient Being Able to be Transferred Immediately to the Diphtheria Ward.

1. The patient is removed from the ward to the diphtheria ward.

2. The ward is not quarantined.

3. The close contacts are noted, and cultures and Schick tests are made.

4. If the ward is not already masked, all patients, orderlies, nurses and ward surgeons are required to wear masks during the period of observation.

5. No patient is transferred from the ward until his culture is reported negative. New patients are masked on admission to the ward.

6. The following morning cultures are examined. If carriers are detected, these are at once removed from the ward and cultures made of the entire ward for further carriers. Schick tests are carried out on patients in the ward.

7. Prophylactic doses of antitoxin are administered to the small number showing a positive Schick reaction.

C. Procedure in Ward Where Diphtheria Patient is Too Ill to be Transferred to Diphtheria Ward.

1. The entire ward is quarantined. All quarantines for diphtheria are instituted and controlled by the public health laboratory.

2. The patient is placed in a single room in the ward until he is able to be transferred. Cultures and Schick reactions are made of the entire ward.

3. If not already masked, all patients, orderlies, nurse and the ward surgeon are required to be masked.

4. On examination of cultures any carriers detected are transferred to the diphtheria ward if their condition warrants; otherwise they are placed in cubicles.

5. Repeated examinations are made by cultures at two-day intervals.

When the patient's condition warrants, he is removed to the diphtheria ward. After his removal, two negative examinations of the ward are obtainable prior to release from quarantine.

D. Procedures Adopted for Diphtheria Suspects Sent to the Hospital for Diagnosis.

1. All suspects are masked on entering ambulances bringing them to the hospital.

2. Such patients are held in the observation ward in cubicles until a laboratory report can be made.

3. Since the membrane of Vincent's angina simulates in many respects

the membrane of diphtheria, a clinical diagnosis of diphtheria, followed by the administration of antitoxin, is not made in the absence of the laboratory diagnosis of diphtheria until smears from the patient's throat are examined for the organisms of Vincent's angina. A diagnosis of Vincent's angina may be made with such facility that no time is lost in the administration of antitoxin in case the condition proves to be diphtheria. It is not unusual to find diphtheria and Vincent's angina coëxistent. The demonstration of the organisms of Vincent's angina does not exclude the existence of diphtheria.

E. *Procedures Carried Out in the Diphtheria and Diphtheria Carrier Wards.*

1. These wards are at all times quarantined, masked and cubicled.
2. Diphtheria patients, convalescent carriers and contact carriers should be segregated in distinct groups.
3. Owing to the fact that the larger number of carriers are physically fit, such individuals, under supervision, are assigned certain outside duties. Masks are worn during this work.
4. Cultures are made at five-day intervals on all carriers. These cultures are made from swabs of the nasopharynx and tonsils. Treatment of carriers is discontinued twenty-four hours before cultures are made. Three successive negative cultures form the minimum requisite for release.
5. Two weeks after discharge from the hospital every carrier is required to report to the outpatient department of the hospital for final culture. A number of carriers discharged after showing three consecutive negatives have shown themselves positive on a final culture made two weeks afterward, necessitating their return to hospital.

Beginning at approximately February 1, 1918, an effort was made to standardize the treatment of all diphtheria carriers. The measures noted in paragraph E of the foregoing section were instituted. The administration of antitoxin to carriers was discontinued as ill-advised. Medical treatment then in vogue was discontinued as unsatisfactory. Treatment was especially directed to the elimination of existing open throat lesions. Tonsillectomy was carried out in a number of cases with a quick termination of harboring diphtheria organisms in all cases. In addition, a systematic treatment with chloramin-T (chlorazene) was inaugurated. This use of chlorazene in the treatment of diphtheria carriers was anticipated by Dunham and Dakin without, however, being used in any actual diphtheria carrier cases. Its application, as we have employed it, consists in the use of an aqueous solution of 9.25 per cent. strength, administered as a gargle three or four times daily. In certain cases the application was made by throat specialists to insure the reaching of remote points in the nasopharynx. The gargling was followed with an oily spray of dichloramin-T of 2 per cent. strength. It may not be maintained that the chloramin action is exclusively responsible for the appreciable reduction of days in hospital of carriers. This is in part due to the chlorazene-dichloramin-T treatment and in part to the general painstaking systematizing of the entire care of such patients. Through the use of these several described procedures it has

been possible to return the carriers to duty after an average of twenty-three days in hospital. During the month of May, the systematizing of treatment made it possible to discharge all diphtheria patients (16 in number) after fifteen days in the hospital, and all carriers (29 in number) after sixteen days in hospital.

With reasonable precautions, diphtheria is unlikely to become a serious menace to the health of army camps.

During the five months covered by this report, 63 cases of clinical diphtheria occurred, with no deaths; 3215 exposed persons were examined, 89 of whom proved to be carriers; the number of carriers detected is 2.76 per cent. of the number of exposed persons examined.

The employment of the system for the care and treatment of diphtheria carriers described in the foregoing has reduced the average stay in the hospital for convalescent carriers from fifty-five days in the first month of this report to fifteen days in the last month of the report, with an average for the four months of twenty-three days. The period in the hospital for contact carriers has been reduced to sixteen days for the last month of the report, with an average of twenty-three days for four months.

Asthma. An entire change from the viewpoint of the profession toward asthma is rapidly taking place. The work of Auer, Lewis, Meltzer, Vaughan, Babcock and others leaves little doubt that the disease, so long known as bronchial or idiopathic asthma, has been permanently removed etiologically from the neuroses and is now fully explained as a manifestation of protein sensitization. Hutchinson and Budd⁵⁶ consider that the paroxysmal outburst represents anaphylactic shock, while the various causes formerly thought to act reflexly, and whose removal often resulted in fewer attacks, are believed to be foci from which the foreign material necessary to induce an attack is elaborated. It is probable that an immunity can be produced provided the specific protein can be isolated in an available form and injected into the sensitized individual in suitable amounts and at proper intervals. The study of a considerable number of cases of asthma suggested the possibility of the presence of the specific protein in the bronchial secretions of the patient himself, and also the possibility of recovering this in suitable form for use in bringing about immunity. Experiments from 1915 up to the present time have been so satisfactory as to warrant further trial. Twenty cases of typical bronchial asthma have been treated, and in 12 of these complete relief from attacks was experienced after from one to five injections of vaccine. The period of relief from symptoms varied from six weeks to sixteen months. In 5 cases there was distinct improvement in the frequency, severity and duration of the seizures. In 2 cases no effect at all was produced. One of these was an elderly man with emphysema and a history of asthma extending over twenty years. The other had a history of ununited fractures of several ribs. Injections have been made in most cases twice a week, but a shorter interval is recommended.

⁵⁶ American Journal of the Medical Sciences, 1918, p. 826.

The vaccine is made in the following manner: 1 c.c. of washed sputum is incubated in 10 c.c. of broth and 1 or 2 drops of guinea-pig serum for a period of forty-eight hours. At the expiration of that time the culture is standardized and killed by heat of 60° C. for a period of two hours. Further decomposition is prevented by adding carbolic acid until a 1 per cent. solution results. This is cultured out to ensure sterility of the suspension. The vaccine is then diluted with normal saline until each cubic centimeter of the suspension contains 500,000,000 to 1,000,000,000; the dose is increased each time by 1 minim. Do not increase beyond 15 minims, although the treatment be continued several weeks after this amount has been reached.

Babcock,⁵⁷ discussing the question as to why one person with chronic ethmoiditis or any other focal infection whether in gall-bladder, tonsils, teeth roots or elsewhere, develops asthma and another does not, or why some food produces asthma in one and urticaria in another, suggests that it might be the anaërobic fusiform bacillus that is the agent furnishing the protein having a selective action on the muscle fibers of the bronchioles because of the circumstance, that when, in a given case, the asthma had led to bronchitis, and when, after removal of the presumably original focus, cultures were grown from the sputa and a vaccine prepared, no improvement had been noted unless the fusiform bacillus was contained in the vaccine.

Syme⁵⁸ proceeds on an entirely different line of treatment, using 10 per cent. silver nitrate solution swabbed on the inner lining of the bronchi through the bronchoscope. He reports 6 cures and two failures. This treatment will never be popular, as the introduction of the bronchoscope as a therapeutic measure is far from agreeable. In the midst of palpable lesion and in the presence of foreign bodies, it will be borne, but hardly as a method of local treatment. W. Freundenthal used this with some success some years ago, but he has had few followers.

Walker,⁵⁹ whose work was referred to last year, in a later paper says that the treatment of sensitive cases is largely a matter of judgment in deciding which positive test should be first investigated.

If the patient is sensitive to food proteins, such foods should be omitted from the patient's diet for at least a month in order to see what effect they have on the asthmatic condition. In this series of cases nearly all such patients have been relieved of asthma. In a few instances, however, because of the associated bronchitis, autogenous sputum vaccines have been required in conjunction with the restricted diet. Attempts to desensitize the patient against offending food protein by the subcutaneous injection of or by feeding gradually increasing amounts of protein have failed. We have reasons, however, for believing that total abstinence from the offending protein for a long interval automatically desensitizes the patient for that protein.

Patients who are sensitive to bacterial proteins may be successfully desensitized against such by treatment with vaccines of those organisms,

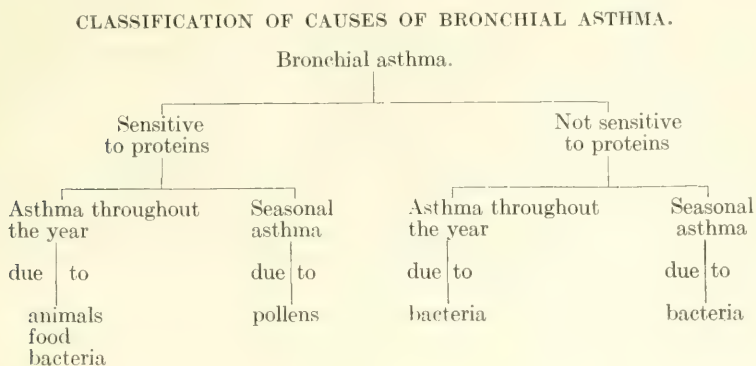
⁵⁷ Medical Herald, July, 1917.

⁵⁸ British Medical Journal, June 30, 1917.

⁵⁹ Boston Medical and Surgical Journal, August 29, 1918.

but great care must be exercised not to give too large and too rapid an increase in the amount of vaccine. The first dose of vaccine should not be larger than one hundred million bacteria, and each succeeding dose should not be more than fifty million over the preceding dose.

The following is a good and useful classification to use in determining the cause and treatment of bronchial asthma.



Although neurasthenic, neurotic and psychoneurotic conditions are frequently associated with bronchial asthma, these conditions are not sufficiently often a cause of asthma to warrant a place among these causes. Furthermore, no provision is made for so-called cardiac and renal asthma, since we do not accept shortness of breath on exertion, nocturnal dyspnea and bronchitis, all of which are associated with cardiac and renal disease, as bronchial asthma. The combination of all of these symptoms does in a way simulate bronchial asthma but for such a syndrome we feel that the term asthmatic bronchitis is more appropriate; such a term would imply bronchitis with asthmatic symptoms, and this is really the true condition present. Cardiac and renal patients may have true bronchial asthma; however, in these cases the asthmatic condition is entirely separate from the cardiac and renal disease; they are two distinct conditions not dependent upon each other.

Hay Fever. Goodale,⁶⁰ whose work on sensitization for asthma and hay fever is already known, his investigations having been begun in 1914, presents the result of his experience during the four years. This study covers only cases in which the treatment has been carried out for not less than two years.

In the examination of a given case of hay fever, the first point to determine is whether the vasomotor symptoms are actually excited by the pollen of plants, or whether they arise in response to a stimulation of the nasal nerves through other agencies. A fairly large proportion of the cases which have come under his observation have shown no response to any of the pollens tested, but have been excited by the fragrance of certain plants, such as lilies of the valley, sweet peas, hyacinths, lilacs, etc. In these plants the amount of pollen disseminated

⁶⁰ Boston Medical and Surgical Journal, August 29, 1918.

must be extremely slight, owing to the relatively small amount produced in the flower, and by the heavy and viscid character of the pollen grains themselves. Tests, moreover, with the pollen in such cases have failed to show a skin reaction, although the patient within the radius of the flower will be thrown into more or less violent attacks of sneezing or even of asthma. Such conditions he has termed olfactory vasomotor rhinitis, or pseudo-hay fever. It is therefore of great importance to test all cases on the skin, even though their symptoms may be distinctly seasonal. In most instances patients whose symptoms develop only in late August and early September have been of the true anaphylactic type due to ragweed.

The pollen is obtained in the usual way as described by Wodehouse. One gram is soaked in a small amount of normal salt solution for forty-eight hours and filtered. The filtrate, which contains albumin, proteose and other proteids, is then treated with sufficient alcohol to bring the alcohol content up to 20 per cent., by which albumen is thrown down in the form of flocculent precipitate. To this fluid is added enough 20 per cent. alcohol to make a volume of 500 c.c. In this, which is termed our standard extract, we have the amount of proteid extractable from 1 gram of pollen contained in 500 c.c. of 20 per cent. alcohol. Dilutions of this are made in the proportion of 1 to 2000, 1 to 5000 and 1 to 50,000. Both in making these dilutions and in giving the injections, the bottle containing the material should be shaken sufficiently to distribute equally the suspended particles of albumin.

The injections are started, if possible, several weeks before the expected attacks, although they have seemed of value even after the symptoms have begun. In the first instance, we may speak of prophylactic treatment; in the second, of abortive treatment.

After the reaction from the first injection has subsided, one may then double the amount, and a few days later give twice the amount of the second injection. The next higher strength of 1 to 5000 is taken, and three injections of this are given, ranging from 3 to 7 or 8 minims. Next, a similar quantity in three doses is given of the 1 to 2000, and finally the full strength of 1 to 500, in doses ranging from 5 to 10 minims. The number of injections required during the first year has ranged from six to fifteen, depending upon the rapidity with which the dosage can be increased.

If the individual reports at the beginning of his hay fever, small daily injections are given without waiting for a subsidence of the reactions, the successive injections being made in the forearms and upper arms respectively. It has not been demonstrated beyond dispute that in these cases there has been a positive arrest of the symptoms as a result of the injections, but, nevertheless, so large a proportion of cases so treated have had the symptoms disappear in the course of a week, which would ordinarily have persisted for six weeks, that it seems worth while to continue this as the best means of affording relief.

At the close of the hay fever season the patient may be assumed to have attained a relatively high degree of resistance to the pollen in question. With the omission of treatment, the sensitization slowly and

progressively returns, until, at the beginning of the following year, the skin tests show the same degree of intensity which they did originally.

Of the true anaphylactic type, 90 were from grasses, 237 from ragweed, 5 from maple, 4 from roses, 3 from oak, 1 from willow and 5 from birch.

Of 330 cases of true hay fever, 123 received desensitizing treatment for two or more years.

1. No improvement noted in 7 cases.

2. Improvement as compared with previous years, but showing, nevertheless, troublesome symptoms for a short time, 46 cases. These patients in general may be considered as only moderately well satisfied with the results, and, in my opinion, were not materially better than most cases treated in previous years by cauterization and general hygienic measures.

3. Very definite improvement, apparently beyond criticism, was observed in 59 cases. These include patients with a previous history of severe attacks, who, under treatment, exhibited only slight symptoms, causing not more than moderate annoyance. Here are included patients with a previous history of hay asthma, who were able to go through two or more summers without asthmatic symptoms.

4. Five patients showed no hay fever for two or more years. By this is meant complete absence of subjective or objective vasomotor disturbance, in spite of full exposure to pollen.

Terry⁶¹ found 71 per cent. of 127 cases relieved of practically all symptoms, while 16 per cent. were more or less benefited, 2 were made worse, 19 were not relieved. Before any very definite results can be formulated, a large number of cases must be tabulated by different observers, over a period of years, and the end-results noted. A number of patients who report improvement in one year do not find as great improvement under the same treatment in subsequent years.

BRONCHOSCOPY AND ESOPHAGOSCOPY.

Bronchoscopy and Esophagoscopy for Foreign Bodies. A dozen years ago the bronchoscopic removal of a foreign body bloodlessly through the mouth was such a marvelous novelty that the report of a single case was an event in literature. With increased experience, the ease and safety with which a foreign body may be removed from the bronchi through the mouth in a few minutes in the majority of cases has led to the reporting of cases in groups, so that statistics on a large scale will soon be available. On the other hand, as stated by Sir St. Clair Thomson,⁶² the complete history of a single case which is full of incidents is sometimes of great value. He reports the case of a healthy girl, aged ten years, who was noticed to be slightly "wheezy" after the extraction of two teeth under nitrous oxide anesthesia. The wheezing was at first thought to be asthmatic, but the attendant, Dr. Smallwood, noted the exceedingly important point that the physical signs were monolateral, and

⁶¹ Interstate Medical Journal, September, 1917.

⁶² Practitioner, August, 1918, ci, p. 61.

suspected the entrance of a tooth into the left bronchus at the tooth extraction. This was confirmed by radiography by Dr. Bruce. On bronchoscopy, Sir St. Clair Thomson found one of the most difficult of mechanical problems. The tooth was smooth, hard of surface, presented a somewhat conoidal form toward the bronchoscopist and was tightly impacted in a small bronchus, the mucosa of which was swollen in the five weeks' sojourn of the intruder, so that the latter was tightly fixed and part of its periphery protected from the grasp of the forceps. Notwithstanding these great difficulties, at the third bronchoscopy the tooth was removed, liberating a quantity of pus that had accumulated below the foreign body. The technical details are of absorbing interest to bronchoscopists. He calls special attention to the value of experience and training in the safe and successful use of the bronchoscope. The article contains references to a number of cases of a tooth becoming lodged in the lower air-passages during extraction. The author deplors the fact that knowledge spreads so slowly that in 1 case a fatal thoracotomy was undertaken without bronchoscopy having been employed. Other cases of aspiration of dental objects are reported by B. R. Shurley.⁶³

One of the most valuable articles that has appeared is that of Herbert Tilley,⁶⁴ who reports 7 cases in which he removed foreign bodies from the bronchi by bronchoscopy and 15 cases of foreign body removed from the esophagus by esophagoscopy. All of the cases recovered except 2. In 1 of these, a child, from whose esophagus a safety-pin was removed, died of bronchopneumonia. The other fatality was due to the perforation of the esophagus by blind bouginage before the patient was sent to Mr. Tilley. He states, and no one familiar with the subject will doubt it, that blind groping in these regions has been responsible for an enormous number of fatalities. For this reason he considers coin-catchers, umbrella probangs and such-like should be relegated to the historical sections of anatomical museums. He urges the use of endoscopic methods only, and states that in practised hands the risks of endoscopy scarcely exist, and therefore the method should only be used by experts or by those who have served a term of apprenticeship with a master of the craft and who will subsequently have frequent opportunities for increasing their experience.

Two cases of foreign body in the lung for prolonged periods are urged as indicating the wisdom of suspecting a foreign body in every case of bronchiectasis or of any unilateral inflammatory affection of the lower air-passages, even though the patient may have no recollection of having inhaled or swallowed any foreign body. The author's technic is given and perusal will be found instructive and very valuable to those doing the work. In the same issue an excellent leading article, clearly and concisely, and with editorial crispness, presents the merits of endoscopy, adding: "The method of endoscopy is now employed by many, but there are still those who for removing foreign bodies from the lower air-passages and from the esophagus use methods which can at best be described as antiquated." A number of such abstract criticisms have

⁶³ Transactions of the American Laryngological Association, 1917.

⁶⁴ London Lancet, February 23, 1918, exciv, p. 283.

appeared in journal articles and in society proceedings, but only rarely has anyone the courage to get up in meeting in which a surgeon has reported a thoracotomy for a foreign body and ask why a bronchoscopist was not given an opportunity before so serious an operation was undertaken.

Homer Dupuy,⁶⁵ however, had the courage of his convictions. At a meeting of the New Orleans Medical Society on the report of a case of esophagotomy for a foreign body in the esophagus, followed by bronchopneumonia and a prolonged convalescence, he made very frank remarks, of which a modified abstract follows: "My remarks are strictly impersonal, as I have the highest regard for this surgeon's technical skill. While those doing endoscopy cannot expect to equal the work of a master in the art, yet the mortality from a properly conducted esophagoscopy is so low while that of esophagotomy is so high that the latter should never be resorted to until all the resources of endoscopy have been exhausted. The surgeon was so fortunate as to pluck success in the face of so many odds, and for this he deserves congratulations. This surgical procedure, however, should never have been practised until esophagoscopy in trained hands had failed. As we see by the history the case was not one of urgency, and thus the question is now brought to one of criticism relative to the hospital authorities. As no dyspnea or other urgent symptoms were present, I feel that this child was not accorded the first, best and safest method of treatment. As a matter of common justice, I wish to say that there are a sufficient number of laryngologists attached to the hospital staff doing endoscopic work to have made esophagotomy an absolutely last resort." It is worthy of note in the foregoing that Homer Dupuy does not consider that "all the resources of endoscopy have been exhausted" unless a bronchoscopy is done by a number of laryngologists doing endoscopic work. Quite a number of cases have occurred in which the surgeon, without previous training with a cystoscope or any other endoscopic method, without even a one-eyed procedure of any sort, has attempted a bronchoscopy. Lack of faith alone is apt to doom to failure such an attempt, to say nothing of the technical difficulties, especially visual, to be encountered to the greatest degree by him who is accustomed to work with both eyes and both hands in an open wound. No one claims that thoracotomy is not justifiable for a foreign body, but all writers familiar with the results of bronchoscopy agree that opening the chest to remove a foreign body that has gone down through the natural passages should not be done until an experienced bronchoscopist has failed. This does not apply to foreign bodies that have gone in through the chest wall. Doubtless a few bronchoscopic removals of spent missiles, stopping so as to be reachable endoscopically, will be reported when the surgical history of the World War is written; but doubtless such cases will be found exceptional, and no surgeon can be criticized for not waiting for bronchoscopy in such cases.

Ellen J. Patterson⁶⁶ has published one of the most important papers

⁶⁵ New Orleans Medical and Surgical Journal, December, 1916, xiv, p. 453.

⁶⁶ Pennsylvania Medical Journal, April, 1918, xxi, p. 448.

of the year. It is fully illustrated and gives much technical detail of interest to those doing endoscopy. No anesthetic, general or local, was used in any of the cases, and in no case was a tracheotomy bronchoscopy done. In 19 out of the 22 cases reported, the author removed the foreign body through the mouth by endoscopic methods, resulting in prompt recovery of the patients. In 2 of the remaining cases, the foreign body was in the stomach and passed naturally. The safe outcome in these cases, the author states, does not justify the often fatal blind efforts to push a foreign body downward into the stomach. In only 1 case was there failure endoscopically to remove the foreign body. This patient, a child, aged two years, was in a dying condition, with a pulse approximating 200 and with a respiratory rate of 70 when admitted. Pneumonia was present, involving the middle and lower right lobes. The child was said to have aspirated a black bean many days before. The frequency of septic pneumonia following the aspiration of a fragment of peanut kernel is noted. Attention is called to the fact that while it is customary to remove artificial teeth on retiring, the danger during dozing is not generally realized. The erect posture in dozing in a chair would seem to favor the accidental swallowing or aspiration of a denture even more than recumbency. In many of the cases, blind methods had been used unsuccessfully, and in some instances with a serious degree of trauma. In a number of instances endoscopic methods had also been unsuccessfully and by no means harmlessly tried.

It was brought out in the discussion of Patterson's paper that both the safety and the success of bronchoscopy and esophagoscopy depend largely upon the skill and experience of the endoscopist, unskilled and untrained endoscopy being considered as dangerous as blind methods. In 1 case, that of an infant, aged fifteen months, with a grain of maize in the trachea, the patient arrived so dyspneic that respiration ceased during an attempt to get a radiograph. It was rushed to the operating room for bronchoscopy. After bronchoscopic removal of the grain of maize and of the accumulated pus and secretions that were drowning the little patient, he fell into the first peaceful sleep he had had for seven days. The bronchopneumonia, from the prolonged sojourn of the foreign body and the accompanying pus in the lower air passages, gradually subsided and the child fully recovered.

The following abstract of the comments of the author are interesting: "That nine physicians consulted in succession should be unaware of the achievements of bronchoscopy in foreign body cases is one of the chief reasons for writing this paper. Undoubtedly hundreds of children die from the aspiration of foreign bodies. In some cases the accident not being witnessed, the possibility of foreign body may not be suspected; but, undoubtedly, in other cases the parent's suspicions are ignored or the fact of the possibility of relief by the bronchoscope in experienced hands is ignored. It is not to be expected that every physician should be trained to do the bronchoscopy himself, and he is not to be criticized for not having in his office a bronchoscopic outfit, but he should at least know that large hospitals in medical centers are equipped to save the lives of these children."

The clear and concise article of I. Seth Hirsch⁶⁷ brings to mind the fact that evidence in overwhelming quantity has now accumulated proving that the man who treats chronic pulmonary disease without the aid of the roentgenologist does not do his patient or himself justice, and this applies equally to cases of disease independent of foreign-body origin. This being the case, what can be said to excuse the practitioner who when told by the patient or his relatives of a foreign-body accident still refuses to sanction the request of the patient for a radiograph? In cases without a foreign-body history there is one valid reason, and that is that poor ray-work is not only valueless but may be actually misleading; and it is only with the greatest technical skill and a very large outlay of time and money that a pair of valuable stereoscopic thoracic plates can be produced. To get this kind of work, in large areas of our country, would require travelling possibly a considerable distance. In such a case it is the obvious duty of the practitioner at least to submit the matter to his patient, whose decision, even if negative, will relieve the physician's conscience. Reports of cases are accumulating, showing the prolonged sojourn of a foreign body whose entrance into the lower air-passages was unknown to the patient or his relatives or was by them forgotten. Still more remarkable are the cases in which the history of foreign body is deliberately brushed aside as unworthy of investigation.

Paul R. Walters⁶⁸ reports the case of a boy who, from his eleventh to his twentieth year, carried a bone in his right bronchus. The symptoms were cough, foul, purulent expectoration, emaciation, chills, sweats, hemoptysis, fever. No tubercle bacilli were ever found in the sputum. During the nine years the boy was under the care of many physicians who made diagnoses of chronic bronchitis, tuberculosis, bronchiectasis and empyema. Rib resection was urged for the latter. All forms of antituberculous regime were followed, including months and months in bed, and many climates were visited. All of the many physicians who saw the boy at various times were told by the mother of the accidental choking on a soup bone just prior to the onset of the symptoms but all ignored the history. When the patient came to him, Walters advised a stereoscopic radiographic examination of the chest, which showed the piece of bone in the lower lobe of the right lung. He then sent the young man to Jefferson Hospital, Philadelphia, where the bone was removed by bronchoscopy under local anesthesia in five minutes forty-five seconds. In conclusion, Walters urges that good stereoscopic plates should be made in diseases of the chest and that more attention should be paid to the statements of patients.

Usually, when a *foreign body reaches the stomach* without having entered the air passages or having lodged in the esophagus, it is considered that all danger has been passed. That such is not always the case, however, is shown by a number of reported cases which point clearly to the necessity for watching such cases until the intruder has been

⁶⁷ American Journal of Electrotherapeutics and Radiology, June-July, 1916, xxxiv, pp. 317, 382.

⁶⁸ California State Journal of Medicine, January, 1918, xvi, p. 42.

recovered from the stools or its point of lodgment determined radiographically. So long as the foreign body keeps moving on, it is safe. If it lodge in the intestines and remain long in one position, many reports show, the danger justifies opening the abdomen.

Lincoln⁶⁹ reports an interesting and unusual case, in which a needle remained lodged in the duodenum for a year. Following a severe head injury, the patient remained in bed for several weeks, partly in delirium. She had a mania for putting objects into her mouth, but was not known to have swallowed anything. After her recovery from the head injury, she complained of sharp pain in the region of the umbilicus, or a little above it, which came on a little while after taking food, the nature of the food making no difference. The pain always ceased at the end of digestion. There was occasional nausea, but no vomiting, and no evidence of blood in the stools. Radiographic examination in connection with the bismuth meal revealed a needle in a perpendicular position, one inch to the right of, and the same distance above, the umbilicus. Stereoscopically, the needle was seen to lie in front of the spine, fairly deep in the abdomen. Although observed for some time, the needle did not alter its position, except for slight lateral movements. At the abdominal operation a blackened and eroded needle was removed from the duodenum behind the transverse colon. The patient made a good recovery.

That the aspiration of foreign bodies into the lower air-passages is, in most instances, a preventable accident due to carelessness is shown by Chevalier Jackson⁷⁰ who analyzes 612 cases occurring in his hospital and dispensary services, and comes to the following conclusions:

"1. The most frequent of all causes of foreign bodies in the air and food passages is carelessness (87.2 per cent.).

2. The most frequent forms of carelessness in the order of frequency are: (a) Carelessness in putting inedible substances in the mouth; (b) carelessness in the preparation of food; (c) in eating and drinking; (d) in permitting children to play while eating, and (e) in permitting toothless infants to eat peanuts, peanut candy or other things requiring mastication.

3. Age seems a very important factor. Of 590 cases, 492 (81.6 per cent.) occurred in patients under fifteen years of age. All cases of watermelon seeds were in the bronchi of children. All coins were in the esophagus of children. Nearly all cases of meat in the unstrictured esophagus occurred in adults. All peanut kernels were in children, mostly children with unerupted molars, and all peanut cases were bronchial.

4. Failure, either temporary or permanent, of the patient's normal protective mechanism was probably a factor of contributory importance in a large number of cases.

5. Physical activities are important etiological factors, especially those associated with deep inspiration, such as crying, coughing, laughing, sobbing and running.

⁶⁹ Canadian Medical Association Journal, September, 1917, v, p. 803.

⁷⁰ Transactions of the Section of Laryngology, American Medical Association, 1917.

6. The influence of poverty in etiology is shown by the fact that 91.9 per cent. of all cases were ward patients.

7. Dental and surgical accidents were responsible for a few cases. A particular form of dental root-canal reamer having reached the bronchi in 3 cases points to a special risk in the use of this instrument. Disease of the esophagus caused substances to lodge in the esophagus in a number of cases.

8. Properties of the foreign body itself, such as size, shape, surface, texture, are important factors as shown by the fact that water-melon seeds occurred only in the trachea and bronchi; coins, chiefly in the esophagus; tacks in the bronchi; pins, chiefly in the air passages."

Bronchoscopy in Diseases. Hubert Arrowsmith⁷¹ calls attention to the usefulness of endoscopy in disease of other than foreign-body origin. He states that "as laryngologists, therefore, as endoscopists *in posse* if not *in esse*, we in our enthusiasm in foreign-body work have very largely lost sight of the greater importance of endoscopy in the diagnosis and treatment of disease; a field perhaps less dramatic, but certainly eventually of greater scientific value. It is fair to assume that pathological states which are recognizable and may be amenable to local treatment are far more numerous than the cases of accidental inspiration or swallowing of foreign bodies. The widespread lack of information among general practitioners as to even the possibility of directly inspecting the esophagus, trachea and bronchi is astounding. If they have heard of such a procedure at all, it is often related only to a rather dangerous, if occasionally successful, method of dealing with the extraction of foreign bodies. Even internists of large experience have been apathetic toward endoscopy as a diagnostic method of precision, perhaps because we ourselves have emphasized too strongly the surgical aspects of tube work. Our published reports may have appeared too exclusively in our special journals. The particular point that I wish to make is that peroral endoscopy has already by its achievement won for itself as demonstrably useful a place in diagnosis and treatment as have ophthalmoscopy or cystoscopy. No intelligent practitioner today hesitates for a moment to submit to the ophthalmoscopist his arteriosclerotic patients; indeed, that is part of his routine. No more would he continue indefinitely a perfunctory treatment of a doubtful kidney or bladder trouble without the counsel of a cystoscopist. He apparently places the peroral endoscopist in an entirely different category, ignoring his possible aid in obscure instances of dyspnea, cough, dysphagia and gastric syndromes, relying here on his 'signs' and 'symptoms,' which are very prone to lead him into serious error, instead of submitting his patient to examination by a capable endoscopist who, in Elsberg's words, probably could transfer the existing trouble 'from the category of internal and obscure to external and within our reach.'"

Arrowsmith urges that endoscopy offers diagnostic and often therapeutic aid in many cases of asthma, bronchial tracheobronchial and laryngeal diphtheria, endobronchial and endo-esophageal neo-

⁷¹ New York Medical Journal, September 15, 1917, cvi, p. 485.

plasms, bronchiectasis, many forms of dyspnea, hemoptysis, stenotic conditions of the air- and food-passages, intrathoracic tumors and abscesses. In conclusion, the author states: "We must recognize that the study of clinical pathology by ocular observation in the living patient is even more important for his welfare than investigations made in the deadhouse and laboratory, when the discovery of vital aspects of his disease is made too late to do him any good. Moreover, by endoscopic study we may learn many things concerning various diseased processes in their early stages which autopsy will never reveal because they are discoverable only during the patient's lifetime. Do not understand that these endoscopic procedures are recommended as part of the physical examinations of every patient. My purpose is to emphasize the importance of, and bring to the attention of our internist confrères, the possibilities of peroral endoscopy in diagnosis and treatment. Only by coöperation between internist and endoscopist can the science advance, for only through the internist can the tube man obtain sufficient material to investigate, whereby he may through many observations and careful study of a multitude of patients attain the diagnostic acumen and therapeutic skill which this method has made possible."

Diphtheria. Henry L. Lynah⁷² reports bronchoscopic study of a number of cases of tracheobronchial diphtheria which corroborates his findings in a previous report,⁷³ and he adds many valuable observations. A number of cases of suspected diphtheria were found to be due to foreign body, no diphtheritic process being present. The converse was true in one case with a history of foreign body, which, however, was not present, the symptoms being due to diphtheria. Such cases have occurred to a number of bronchoscopists. Lynah has made a number of discoveries in the new field of bronchoscopic study of tracheobronchial diphtheria, one of the most important being in the action of detached casts of membrane. In some of the reported cases a detached membranous cast of the trachea or a bronchus acted as a foreign body, and was, by preventing the passage of air, slowly asphyxiating the feeble patients. Bronchoscopic removal of the cast gave prompt relief, and the patients, without complications, recovered. The lives of these patients were undoubtedly saved by the bronchoscopic procedure. A number of the cases in earlier stages, with adherent membrane in the trachea or bronchi, were treated locally with antitoxin. No anesthetic was used in any of the cases, being considered inadmissible in patients so ill. That it would have been wholly unnecessary anyway was indicated by the fact that many of the little patients fell asleep with the bronchoscope in place in the tracheobronchial tree. Some of the patients had had morphine and atropine for stimulation. The article is too full of valuable material to permit of justice being done in an abstract.

Cicatricial Stricture of the Esophagus. Charles J. Imperatori⁷⁴ has had excellent results in cicatricial strictures by esophagosopic bouginage under guidance of the eye, no anesthetic, general or local, being used. He believes gastrostomy rarely necessary, water hunger being overcome

⁷² Laryngoscope, June, 1917, xxvii, p. 93.

⁷³ Ibid., p. 734.

⁷⁴ Ibid., p. 796.

by the Murphy drip method. He points out that esophagitis and ulceration can be seen and treated locally, and the bouginage carried out through the tube with an accuracy and safety impossible of attainment by blind methods.

Tonsils. The usual large amount of literature in connection with the tonsil operation has appeared this last year and will doubtless continue until a more definite knowledge of its exact function has been worked out. Swain,⁷⁵ who deplores the indiscriminate attack upon the tonsil now being made by operators with, and without, experience, and frequently without knowledge that the operation is really needed, lays down the postulate that logically tonsil tissue must have a function, and, if so, it is to the young that it is of most value. Children with merely large but not diseased tonsils should have some healthy tonsil tissue saved to them. The focal infectionist has lighted upon the tonsil and the teeth, and demands their removal. The universal opinion that general infection may originate in diseased tonsils has been expanded into a theory which claims to cure by tonsillectomy chronic arthritis, chronic nephritis, goiter, asthma and many other things, with the assurance of a patent medicine advertisement. A real focus of infection with the tonsil shows itself by the infection of the nearest lymph glands. The popular mind has been imbued with the craze, and especially the district nurse and the school physician. Many children show up at our clinics sent by the nurse or school physician, and when asked what the trouble is, reply, "Tonsils." "Sore-throat?" "No." "Who sent you?" "The school doctor." Examination shows an enlargement of what are apparently healthy tonsils, the only pathological thing that can be discovered being their size. It is the reviewer's experience that these tonsils give practically little trouble, but it is the small, unnoticed tonsils, pretty well covered by plica and the anterior and posterior pillars, exuding purulent debris on pressure which are the really dangerous tonsils. Mere enlargement does not indicate operation nor does removal give immunity from colds. Swain does not think it is necessary always to remove the tonsils when operating for adenoids. His views do not command general assent but the consensus of opinion is rather with Layman⁷⁶ who favors complete operation but cautions as to the time. He says tonsillectomy should not be performed closely following convalescence from an acute purulent infection, such as middle ear, nasal sinus or upper respiratory tract or acute exacerbation of some systemic disease. Reports show that such cases have developed septicemia. In other cases it is better not only to wait for a considerable time to elapse before proceeding with tonsillectomy, but to take a preliminary culture and cleanse the tonsil crypts by suction and antiseptic applications. In some, the use of vaccines may be a valuable adjunct. If these acute infections have been treated in a hospital, the patient should be discharged temporarily before undergoing the operation. Some patients need prolonged treatment with a view of establishing sufficient resistance to enable them to bear such surgical procedure as tonsillectomy.

⁷⁵ Medical Record, June 22, 1918.

⁷⁶ Transactions of the American Laryngological, Rhinological and Otological Society, 1917.

The reports of competent pediatricians and of medical men connected with contagious disease hospitals, after years of clinical experience, show that the tonsil is a greater menace to health in early childhood than is generally recognized.

Whatever advantage the tonsils may have physiologically, it would seem that Nature has provided sufficient other tissues of the same sort to take up vicariously the work of the tonsils when these are removed. As regards their susceptibility to disease, children whose tonsils have been removed are much less susceptible to respiratory and gastrointestinal disturbances of all sorts. Moreover, when they have measles, scarlet fever or whooping-cough, the disease is much less severe than it would have been had their diseased tonsils been present.

Forbes shows from the reports of health officers that from 80 to 100 per cent. of the contagious disease cases have tonsils; also that tonsils were nearly always present in the cases which developed complication. Lynah, of New York, writes: "In our contagious disease hospitals the percentage of admissions in whom tonsillectomy has been performed is from 2 to 4 per cent. The other 96 to 98 per cent. have tonsils in various degrees of size."

Regarding the association of the tonsils and dentition, one occasionally reads in medical literature that one of the functions of the tonsil is an association with dentition, as the tonsils become swollen and inflamed with the eruption of the teeth, and, when the tonsils are removed in infancy and childhood, there follows a deleterious effect on dentition. This question was submitted to twelve of the best orthodontists and oral surgeons in America, and they denied, without exception, that early removal of the tonsils had any effect whatever on the development of dentition, and I know of no evidence that tonsils under normal conditions are in any way connected with their development."

In view of these reports and the attitude of the most prominent pediatricians and health officers in the country, we should seriously consider the removal of the tonsils as a wise prophylactic measure in early childhood in many more cases than formerly. This will be an advance in preventive medicine and will thereby lessen the number of tonsillectomies that have to be performed in adolescence and adult life in the treatment of well-established systemic diseases.

George B. Wood⁷⁷ believes that whenever, in cases of arthritis or other constitutional disease, the crypts of the tonsils contain cheesy debris with enlargement of the tonsillar lymph nodes, the tonsils should be held responsible. In other cases the tonsil may be at fault and no visible tonsil abnormality be found. When in doubt, the patient should be given the benefit and complete enucleation of the tonsil performed. These tonsils are usually small and submerged, and exude pus only when pressed upon by direct pressure upon the anterior pillar.

It has been the reviewer's experience that most cases of chronic arthritis or chronic rheumatism, even when lasting over a period of years, have been much improved by the removal of the offending tonsil.

⁷⁷ American Journal of the Medical Sciences, August, 1917.

The pain has diminished and the operation has seemed in every instance to have been worth while.

Infection from incompletely removed tonsils, according to Loeb,⁷⁸ may be due to poor technic, operators' accidents, or to the very general feeling that if the bulk of the tonsil is removed, the remaining tonsillar tissue will atrophy, or, in some pleasing but indefinite way, will disappear altogether. This encourages the operator to desist in his work even if it is incomplete, a not uncommon occurrence. If a portion of the tonsillar lymphoid tissue is left after operation, especially if it happens to contain a crypt, it is very much inclined to persist *in statu quo*. It may never occasion any unpleasant result, but the susceptibility to infection is there. He reports several cases, and refers to others, in which infectious arthritis occurred in tonsillectomized patients in whom one or more crypts have remained after the tonsillectomy. These cases show definitely that small masses of tonsil tissue may be overlooked, or at least not removed at the operation, and that these are susceptible to infection, with the remote effect similar to those which follow acute tonsil infection. They presented a decisive argument against any form of operation which does not contemplate the entire removal of the tonsil, especially where there have already been some infective processes originating in the tonsil, and suggest the advisability of following up all cases of tonsillectomy to determine whether any portion remains and whether it has become a focus of infection.

Pugnat⁷⁹ comments on the very frequent occurrence of *angina of the tonsil following operations on the inferior turbinates*, appearing usually in the tonsil of the same side two or three days after the operation. Some think the infection results from septic products reaching the surface of the tonsil. Others think the infection travels by way of lymph channels which run from the nose to the tonsil, the latter acting like a draining lymph gland for the nose, the angina being then really an adenitis. Anatomy does not show any such connection. Various experiments have been tried to prove it, such as Schonemann's injection of iodine under the mucous membrane of the inferior turbinate, and finding it later on removing the tonsil of the same side. The experiment was valueless because of the vascular diffusibility of the iodine. Lenhart did the same thing in rabbits, injecting cinnabar which he later found in stained sections of both tonsils, some free in the sinuses, some in leukocytes. In 1914, Henke repeated this on man, with the use of lamp-black which he recovered in the lymphatics but not in the tonsils, since this organ had eliminated the granules through the surface into the pharynx.

Amersbach proved just the opposite after careful use of lamp-black and cinnabar, neither of which could he recover in the tonsils of man or beast. In some sections, however, he saw small droplets of water which much resembled granules of cinnabar and which he claims were the granules seen by the other two observers.

He repeated these experiments in hundreds of children and made

⁷⁸ Annals of Otology, March, 1918.

⁷⁹ Revue de Laryngologie, July 15, 1918.

serial stained sections of tonsils after injecting lamp-black, and in no one did he find any lamp-black. He concludes that there is no direct lymphatic connection between the nose and tonsil. The latter is not a lymph gland which drains the nasal turbinates. Postoperative angina is not an adenitis nor an ordinary "secondary" process, but of quite different origin.

B. S. Cornell,⁸⁰ after unsuccessful attempts to rid the tonsils of diphtheria, first tried living cultures of *Staphylococcus pyogenes albus* as sprays over the tonsils in the hope of outgrowing the diphtheria bacillus, and found that although the next day the swabs were negative for diphtheria and loaded with staphylococci, a few days later the diphtheria bacilli returned in large numbers. Complete enucleation of the tonsils, however, entirely removed the diphtheria organisms. He, therefore, recommends complete tonsillectomy in all cases in which the tonsil remains as a diphtheria carrier.

Bloom,⁸¹ after eighteen months' observation on the mental and physical state of children following the removal of tonsils and adenoids, finds marked improvement in cases in which there have been frequent colds, tonsillitis with temperature, more or less persistent sore-throat, frequent attacks of suppurative otitis media, mouth breathing and suppurative lymph nodes. The largest tonsils came from cases that had previously had scarlet fever and measles and the smallest from those who had mumps and whooping-cough. There was marked improvement in weight after ten years of age. Ordinarily, in the absence of temperature, the author does not advise removal under the age of six years.

Mitchell⁸² finds *tuberculosis of the upper deep cervical glands* to develop from a primary focus in the tonsils much oftener than is generally supposed. Infection can only be detected by the aid of a microscope and inoculation experiments. The lesions are principally found just under the surface epithelium and near the mouths of the lacunæ. The size and shape of the tonsils do not show any relation to the tuberculous infection. In 106 cases the tonsils were small and submerged in 51, in 27 cases large and in 28 medium. All milk given children should be boiled. Many fatalities and a considerable number of cases of subsequent lesions, such as abscess of the lung, continue to be reported as sequelæ to tonsil operation, far more than seems to the writer should be necessary if the tonsil operation is done with the same care and attention to technic as are other surgical procedures, although, considering the situation of the tonsil at the entrance to both the air tract and the digestive tract, absolute asepsis, either in operation or subsequent thereto, is impossible, nor can surgical rest be obtained during the convalescence, as both air and food must pass in close contact to the operative field.

Mortimer⁸³ considers fatalities which follow tonsil and adenoid operations to be mainly due to faulty administration of the anesthetic and respiratory obstruction, shock and hemorrhage. As tonsils and

⁸⁰ British Medical Journal, November 24, 1917.

⁸¹ New Orleans Medical and Surgical Journal, April, 1917.

⁸² Journal of Pathology and Bacteriology, April, 1917.

⁸³ Practitioner, November, 1917.

adenoids encroach upon breathing space, the patient starts with a certain amount of respiratory interference which may be still further increased by the encroachment upon the breathing space by pieces of tissue, blood, mucus and a multiplicity of instruments.

Weinstein⁸⁴ reports a case of *lung abscess* following operation in which four days after operation, the patient was seized with a violent attack of coughing. Two days later she was in bed with chills and fever, violent pain in the left side of the chest, unabating cough and foul expectoration. Eighteen days later, after an attack of violent coughing, there was expectoration of a large amount of foul putrid matter, cyanosis and a weak pulse. The following day the symptoms disappeared and the patient felt well. These cases of lung abscess have appeared at various times and at varying intervals after the operation. The reviewer has had one such case, but whether the abscess which appeared some three weeks after the tonsillectomy, which again had followed a sub-mucous resection in which an abscess had formed between the flaps, was due to the abscess of the septum or to infection from tonsillectomy, he is unable to determine. The patient had left the hospital and gone to work. Recovery occurred, but only after the resection of a portion of a rib and after a rather long and tedious illness. The amount of pus evacuated was very small, and the symptoms and temperature were more suggestive of tuberculosis than of anything else; no tubercle bacilli could be found in the sputum and the probable infection was from the nose and throat operation. The number of cases of lung abscess and other infections following tonsillectomy, recorded in the last ten years, have been quite considerable in the aggregate, though small in comparison with the number of tonsil operations performed.

VINCENT'S ANGINA. Vincent's angina has arisen from a normal of 2 or 3 per cent. in the troops of the French Army up to 23 per cent. in all cases of throat trouble. It is characterized by the formation of ulcers on the buccal mucous membrane, superficial or deep, and covered by a pseudomembrane. The tonsil is the most common site. There are two varieties of organisms, the *Bacillus fusiformis* and Vincent's spirochete, and two forms of the angina, the pseudomembranous, resembling diphtheria in appearance and with abundant bacilli mixed with cocci, and the ulcerative form with bacilli and a Gram-negative mobile flagellated spirillum. A coëxisting streptococcus infection is not uncommon and may give rise to serious complications.

Bouty⁸⁵ states that the most efficient treatment is tincture of iodine, 6 per cent., applied thoroughly after the removal of the membrane. A single dose of antidiphtheria serum has given much relief and one dose of salvarsan intravenously has been said to modify this condition and to prevent its recurrence. The Ziehl-Neelsen method of staining is all that is required, although the silver method demonstrates the spirochete more clearly. Before the war the disease was rare in Europe and practically unknown in America. In France it is believed to have been caused by overuse of cigarettes and is now one of the common disabilities.

⁸⁴ Medical Review of Reviews, August, 1917.

⁸⁵ British Medical Journal, November 24, 1917.

The breath is extremely fetid, but markedly different from that of diphtheria. There is some difficulty in swallowing, the cervical glands are large and tender, the temperature is slightly elevated and the pulse and respiration hardly any. The absence of headache, myalgia and marked prostration is in marked contrast to diphtheria and tonsillitis. In a well-developed case the membrane is yellowish gray and, on removal, leaves a freely bleeding surface. In advanced cases the whole tonsil may be eaten away. Pyorrhea caused by Vincent's organisms is also frequent; the teeth may become loose and in advanced cases may drop out. Some cases are of the bronchial type, running about three weeks without visible lesions in the mouth or throat, but with copious expectoration, general depression and slight fever, the sputum being loaded with Vincent's organisms. Four cases were seen in men with long prepuces, accompanied by considerable edema of the foreskin, the typical membranous ulcers on the inner surface, some of which spread to the glans. Infection was due to uncleanness in shaving. The incubation is unknown, but is sometimes evidently short. Existing syphilis, or the use of mercurial treatment, favors the development of the disease.

In addition to the treatment given above, Campbell and Dyas⁸⁶ recommend the routine treatment of liquor arsenicalis swabbed over the infected area three or four times a day, as well as a soothing antiseptic mouth-wash. Most cases are cured in from four to seven days.

Roberts⁸⁷ says the throat clears up in twenty-four to forty-eight hours under the use of the following lotion:

Hydrogen peroxide	5 ounces
Wine of ipecac	3 drams
Glycerine	5 drams
Water to make	8 ounces

Voice Strain. Howel⁸⁸ urges the laryngologists to pay more attention to those patients, especially singers, who consult them for voice strain, slight hoarseness and the like. Careful study will usually show faulty use of the voice or an attempt to do more with it than Nature will permit. Vocal nodes are common in the experience of every laryngologist. In such cases the upper notes remain clear because when the cords are tense the edges do not rub, but in the middle voice and piano notes the cords are relaxed and at their most convex point, from the attrition of the edges the nodules quickly develop. In all cases of vocal disability due to voice strain, examine for the bulging margins of the vocal bands. The little vibrating pearl of mucus reveals the point of origin of the vocal nodules. Local measures and prolonged rest are the usual treatment prescribed. Applications, inhalations and sprays have little effect, except to soothe or act as a slight counterirritant. Prolonged rest is usually out of the question. Instead of that the patient should be given exercises to counteract the damage done. In the same fashion as one who has tired his arms by climbing a rope can quickly restore

⁸⁶ Journal of the American Medical Association, June 2, 1917.

⁸⁷ British Medical Journal, December 15, 1917.

⁸⁸ Annals of Otolaryngology, September, 1917, p. 643.

their elasticity and vigor by using the punching-bag, so substitute those methods that exercise and in a way massage the cords, but do not permit them to touch. The patient must whisper instead of being allowed to talk, and is required to practice humming exercises for every hour during the day for a few minutes. The technic of the hum is as follows: Some air is drawn through the mouth, then close the lips with the teeth a pencil's breadth apart, think of the word "maw" or "naugh," in the most comfortable pitch of his middle voice and then first sing the word in the closed mouth, bringing it forward until one can feel the lips vibrate with the sound, when by flecking the under lip the explosive note "maw" or "naugh" escapes.

By ascertaining in this manner that the sound is correctly placed, let it, as it were, burst through the lips. It should be clear and even. After some practice he can go up and down the scale with it, and then in a day or two he may try his songs, using, however, the word "maw" at first in place of the words of the song.

In a remarkably brief period voices have been restored by this method and the patients been enabled to return to their occupations.

Larynx—New Camp Disease. Owsley⁸⁹ reports a new camp disease of the larynx which shows ulceration of cords in the initial stage of disease, with bilateral symmetrical opposed elliptical patches usually affecting the anterior third of the cord on the superior surface and involving the free border. The ulceration may be in the center, but, as a rule, is on the anterior third; it may extend to the anterior commissure to the arytenoid attachment and ascend to the ventricular bands or to the subglottic structures but does not extend beyond arytenoids.

Ulcers are of plaque form covered with grayish patches, and may be overlooked in cases of overhanging epiglottitis.

The etiology seems to be lowered vitality following measles, pneumonia, mumps or bronchitis which prevail in camps or exposure to moisture, fatigue or sudden fall of temperature. Forty cases examined microscopically showed pneumococcus constant and predominating and 4 showed pure pneumococcus.

SYMPTOMS. There was aphonia in 85 per cent. of the cases. In the remaining 15 per cent. of cases hoarseness was the first symptom. "No sore-throat" is the customary assurance. There were severe night attacks of paroxysmal coughing, with expectoration of thick, tenacious mucus, which is very hard to loosen. The aphonia lasts over a long period of time, with few or no constitutional involvements. When aphonia is the only symptom, ulceration is not so extensive as when hoarseness is present.

The laryngeal picture of ulceration distinguishes it from simple laryngitis. There may be great difficulty in distinguishing it from syphilitic laryngitis, as its clinical picture is almost identical, but absence of history, with the presence of pneumococcic infections, will usually determine the diagnosis.

The constant selective affinity of laryngeal tuberculosis for the pos-

⁸⁹ Surgery of the Head, Washington, 1918, No. 3, vol. 1.

terior segment of the cords should differentiate it from that disease. Time makes little difference in extension or appearance of the ulceration, but does, however, in prognosis.

This disease, if of long standing, tends to become chronic. If treated early, during the first few days or within two weeks, ulceration disappears after a short course of local treatments, and the normal voice returns. In cases of a month or more in duration the ulceration clears slowly, but the aphonia remains more or less persistent. Electric current stimulation gives excellent results in treating the aphonia of long-standing cases. In the chronic aphonia cases, the adductors work normally, with the exception of the transversalis. This leaves the triangular space behind the arytenoids open with resultant aphonia.

TREATMENT. Silver 2 per cent. increased to 5 per cent. when necessary, and interrupted faradic current to restore the voice. Rest of the voice is not necessary when hoarseness without aphonia is present.

War Surgery of the Larynx. Thollon and M. Labernadie⁹⁰ describe contusion of the larynx. The case reported is 1 of 4 occurring in two years at the front in which a ball or shell has penetrated the anterior part of the neck, causing a superficial wound and reappearing 5 to 6 cm. distant without fracture of the laryngeal cartilage. The cases come to the laryngologist with external wounds well healed, but with difficulties in phonation.

Each case has shown almost complete aphonia. The patient has described a sense of blow at the level of the larynx as if his breath had been cut off for a few seconds. Then a burning due to the wound, then hoarseness has come on. No bitonal voice, no dyspnea, no pain in the throat was present; one case complained of slight dysphagia for a short time. A-rays were negative; no foreign body was present.

Laryngeal examination has shown in each case a bluish ecchymosis of variable size in the upper part of the larynx on the circumference of the glottis and even along the lateral pharyngeal wall. No pain on pressure over the larynx.

Photographs of 1 case show, along the right lateral pharyngeal wall, a bluish ecchymosis, sanguinous submucous infiltration rising quite high behind the soft palate and descending to the level of the glottis and spreading into the right glosso-epiglottic fold. The ventricular bands are swollen and almost covered the true cords, only the free edges showing during contraction. Laryngeal membrane red, no exudate, cords slightly infiltrated.

Another case showed a similar ecchymosis in the region of the cartilage of Santorini, with great edema and congestion of the false cord, while the true cords were thickened and gray in color.

The outcome of these cases was simple: They were given absolute rest, no inhalations and insufflations with morphinated powder. The ecchymosis gradually disappeared in about twenty days, congestion became less and the voice was normal in the same time.

The explanation of these cases is probably as follows: The shot

⁹⁰ Revue de Laryngologie, July 31, 1918.

struck the sides of the larynx at a moment when the latter only loosely held by its muscles was not firmly fixed and sliding along the side violently displaced it. The result was a sudden pulling and rupture of the capillaries, and hence submucous hemorrhage and ecchymosis.

Brindel⁹¹ reports a case of *thyrotomy for projectile in the larynx*. Suturing the laminae of the thyroid cartilage after thyrotomy is not necessary, apposition of them and suture of the soft parts being sufficient. If denuded only in the midline, perichondritis and postoperative sloughing of the cartilage are avoided. Hemorrhage into the trachea can be prevented by a sand-bag under the shoulders (Rose position).

The wounded man was shown by the x-rays to have a projectile in the region of the larynx. Previous operative search had been made in the carotid region unsuccessfully. Under cocaine the laryngoscope showed a body in the left part of the larynx near the midline, below the anterior part of the vocal cord covered with smooth mucous membrane. A midline incision into the thyroid cartilage showed a small denuded and metallic surface emerging from a round tumor covered with mucous membrane. Incision of this freed the ball, which was extracted with forceps, being encased on the inner surface of the thyroid cartilage. Convalescence was uneventful. At the time of injury there was some hemoptysis followed by subcutaneous emphysema, the only result of the bullet passing in at the back below the angle of the scapula through the mediastinum, past the lung and across the base of the neck.

Laryngeal Cancer. Arrowsmith⁹² says when one considers the hopeless prognosis in laryngeal cancer without operation, that operation is justified, even if the mortality is high. Quoting Beck,⁹³ who claims that if 1 case in 100 will recover following such heroic measures, that was 100 per cent. of cures, because without this procedure the patient would succumb to the disease. Most cases are referred to the laryngologist too late for anything but radical surgery. The choice as to thyrotomy or laryngectomy must depend upon the location and extent of the disease. Antecedent tracheotomy should be made two weeks before, so as to accustom the lower air passage to the direct impact of air, and made high so as not to interfere with the later mobilization of the trachea. He prefers oil-ether colonic anesthesia of Gwathmey as making the whole procedure easier for both patient and operator. With rectal anesthesia, larynx spasm does not occur; bleeding is very much less and there is no tracheal or bronchial irritation from the directly inspired anesthetic, thus requiring much less use of the suction apparatus and much less likelihood of postoperative vomiting. He regards this operation as belonging to the field of the laryngologist. The question of loss of voice or not must be regarded as a minor one, as these patients are no worse than the blind, deaf or hopelessly crippled. An intelligent buccal voice is frequently obtained. Three cases are reported, with one cure. Feeding is begun at once by nasal feeding tube

⁹¹ Revue de Laryngologie, July 31, 1918.

⁹² New York Medical Journal, June 15, 1918.

⁹³ Laryngoscope, March, 1918.

carried into the esophagus, taking the place of the old "no food nor water by mouth for five days" dictum.

Beck has had no result of any permanent value from experiments with autolytic solution injections, radium drip, *x*-rays and diathermia-therapy. Surgery is, up to date, the only means of combating the disease, and this is too often defeated of a cure by recurrence. Such cases are usually reported too early.

The principal causes of failure are:

1. The patients present themselves too late for us to make an early diagnosis.

2. Timidity in operating extensively, especially in the removal of the tributary glands.

3. Implantation carcinoma along the field of operation. He reports 34 operated cases, of which 26 have been followed up to date. Of these, 5 are still alive, 3 were laryngectomies, eight years, five years and three months since operation; 1 laryngeal fissure, five years since operation; 1 indirect laryngoscopy, now eleven and one-half years since operation.

Laryngectomy. Canuylt⁹⁴ has operated in 16 cases, with 100 per cent. surgical cure. This success depended on (1) operative technic based on preliminary tracheotomy, local anesthesia and total extirpation from top to bottom; (2) postoperative care which constitutes 50 per cent. of the curative factors. This is given in detail, since it is the portion of the technic quite as important, perhaps more so, than the details of the operation.

The Wound. During the first few days of swelling, hot-packs and zinc oxide ointment, iodoform gauze removed on the fourth day and changed at each dressing. Watch must be kept for sloughing of the esophageal and lateral pharyngeal walls behind a healthy external wound, and the condition recognized and treated immediately by frequent dressing each day.

The Dressing. This is double to cover both the wound and the tracheal tube. The wound is covered with a few thick compresses lengthwise, above these a gauze compress so folded as to surround the cannula and separate its top from the skin. More compresses, cloth and bandage. Finally, a sheet of some impermeable material to separate the dressing from the bloody or purulent tracheal discharge.

Several compresses, tent-shaped, are held over the cannula by a string around the neck. These should be warmed, especially when transferring from the operating room to the bed.

A protecting sheet should come down from the lower lip to avoid soiling the dressing during spitting and coughing.

The Cannula. Lombard's cannula is essential. Frequent cleaning is necessary by removing the inside of the cannula whenever it becomes filled. It should be cleaned with gauze, washed carefully and then boiled. The external cannula should be removed as little as possible and the internal cannula should be replaced completely and clear to the bottom, in order to prevent any obstruction by intratracheal secretion.

⁹⁴ Revue de Laryngologie, July 15, 1918.

The day following the operation the outer cannula should be wiped at the same moment that the patient expels spit, thus avoiding the painful cleaning of the inner cannula.

The Patient. The operating room should not be too warm, 16° to 18° C. Bed well warmed but not sufficient to cause perspiration. Instruct the patient not to cough or spit unnecessarily, but, if he must, to clear the trachea well. Not a word to be spoken, but a card supplied on which to write. *Position:* A little on the side on return from the operating room, with back and head supported, bent forward and immobilized. Raise progressively and rapidly with sitting posture maintained except during sleep. Rubber cushion to secure quiet.

An esophageal sound, plugged with cork held by silk threads in rubber tubes tied behind the head, prevented from pressing on ears by a transcephalic string. The patient is told to hold the sound in when he coughs. A nurse cleanses the nares. The first day the mouth is to be cleansed with a swab and Vichy water, and is not to be opened wide for fear of nausea. The next day the patient rinses the mouth with a wash, with the head back but not gargling.

General Care. Examine the lungs twice daily, watch urine, take pulse, respiration and temperature twice a day; salts are to be given daily, an enema once a week. First day, morphine, grain $\frac{1}{6}$, if absolutely needed; avoid if possible. Give some expectorant.

Feeding by Esophageal Sound. 1. *Technic.* Best introduce food by a 100 c.c. syringe. Boiling water should be at hand with which to rinse the syringe. Fill the syringe, hold it vertically so that no air will be introduced into the stomach. Uncork the sound, hitch the syringe tight, avoid kinks in the sound and hold it without pulling on it. Push piston slowly and steadily, but not too fast. No food is to be allowed to come up through the sound. After the meal, rinse with Vichy water, wipe the mouth of the sound and replace the plug.

Food. Do not force it. First day, Vichy water, then tea, champagne, milk mixed with Vichy. After forty-eight hours, tea, tapioca, milk. On the third day, a regular diet of bouillon and scrambled eggs, milk or coffee, tapioca, purée of potato, beans, peas, etc. Glass of wine, chocolate, etc.

Keep track of the patient's weight.

Remove the sound as soon as the wound is healed. Try the ability to eat and drink before removing. It should be changed every fifteen days and removed from the fifteenth to fiftieth. If the wound for any reason fails to heal properly and patient is not gaining, remove the sound and feed as if normal.

The tracheopharyngeal opening may be closed later by a plastic, with or without reintroduction of the sound.

Tuberculosis. Ladd,⁹⁵ from a study in a large number of children, finds the tonsil the principal port of entry in cases of tuberculous glands. Infected teeth and adenoids may also be primary foci. In over 90 per cent. of his operative cases he got primary union and in the same percent-

⁹⁵ Surgery, Gynecology and Obstetrics, April, 1917.

age in a series of 119 cases there was no further evidence of tuberculosis in examinations made from one to five years after operation. The best cosmetic result is obtained by transverse incision in one of the natural folds of the neck.

Arrowsmith finds the lesion of laryngeal tuberculosis to originate almost invariably from surface contamination, and very rarely by way of the blood and lymph streams. Infiltration without discernible erosion does not disapprove this point of view, as bacilli are known to have the power of penetrating intact mucous membrane. He is in favor of amputating the epiglottis and finds but little reaction to follow the operation. It almost always gives relief to the dysphagia and odynophagia in the absence of ulcerated conditions in other locations. In superficial ulcerations, the galvano-cautery applied under direct exposure is satisfactory. Deep ulcerations can be reached and thoroughly curetted and cauterized. Deep penetration with a fine cautery point has a satisfactory effect on infiltrated areas and is the ideal way of attacking abscesses occurring with perichondritis. Only slight postoperative disturbance follows.

Larynx—Pulmonary Tuberculosis. Lorenz,⁹⁶ as a result of the examination of 300 men suspected of tuberculosis, found certain changes pretty uniformly suggestive of an incipient pulmonary tuberculosis. These are hyperemia of the arytenoid mucous membrane, interarytenoid villous formations, soft dusky color and resembling the filiform papillæ of the tongue. They are to be distinguished from the villous formations of chronic laryngitis by their grayish color and by their occurring discretely and independently of any other lesion of the mucous membrane.

Foreign Body in the Nose. Erath⁹⁷ reports a case in which a soldier was wounded by a ball which entered above the spine of the left scapula, passed subcutaneously up the neck across the base of the tongue through the hard palate finally resting in the left nasal fossa. In so doing it penetrated the inferior turbinate, burying itself in the posterior ethmoidal cells and injured the internal wall of the left orbit. There were slight hemorrhages at the time of the wound. Following the healing of the external wound, he continued to have headache on the left. Vision became impaired and in a few days severe pain appeared, with lachrimation and purulent discharge from the left nostril. Several physicians treated him without success. His general condition became worse, he lost weight and strength and became anemic, complained constantly of headache, retro-ocular pain, lachrimation and purulent discharge. He showed some exophthalmus, pupillary dilatation and slight choked disk. He was seen two years after the injury. The membrane of the nose was hypertrophied, reddened, congested and covered with pus. After cocaine and adrenalin, pus was seen coming from the middle meatus and cleansing of the surface showed nut-sized black body in the superior posterior part of the left nasal fossa. The body was hard, firmly fixed and on scratching with forceps showed bright streaks. The

⁹⁶ Joltrain and Petit-Jean: Presse médicale, April 2, 1917.

⁹⁷ Revue de Laryngologie, July 31, 1918.

patient had no knowledge of any foreign body in the nose but the course of the bullet which had entered through the scapula led directly to this one in the nose. With complete cocaine anesthesia the bullet was, with difficulty, dislodged and extracted. It was covered with a bronze jacket and was normal in shape. A small hemorrhage followed, but the nose was completely healed in two weeks. The next day lacrimation and headache disappeared, as well as the retro-ocular pain and discharge. The exophthalmos also disappeared and the vision, which was almost nil, finally returned to $\frac{5}{100}$.

The remarkable facts of this case are that the man did not know that he had a bullet in his nose; that the doctors for two years did not find it; that a bullet of grape-shot size can be extracted through the nostril without injury to the mucous membrane. The elasticity of the nasal skeleton is sufficient to permit the passage of relatively enormous objects and with proper light, preparation, adrenalin and patience, many rhinotomies can be avoided.

INDEX.

A

- ABSCCESS, cerebral, complicating head wounds, 34
- retropharyngeal, 83
- Acidemia, gas gangrene and, 243
- Acidosis, infection of upper respiratory tract and, 161
- Acute infectious jaundice in United States, 180
- lobar pneumonia, 197
- Adenitis, cervical, *x*-rays in, 93
- Aërocele, intracranial, 56
- Air space required by institutional children, 248
- Alcoholic injection of Gasserian ganglion, 61
- Anemia, pernicious, in young infants, 255
- Angina, Vincent's, in an unusual form, 241
- trichloroacetic acid in, 243
- Ankylosis of jaw, 73
- Anthrax at Camp Hancock, Georgia, 165
- Antimeningococcic serum, potency of, 186
- Antipneumococcus serum in lobar pneumonia, 203
- potency of, 203
- Antipoliomyelitis serum, Nuzum's, 216
- Rosenow's, value of, 215
- Antiseptics, action of, on bacillus Welchii, 243
- Apparatus, new hearing-test, 276
- Artificial ear drums, 294
- Asthma, 309
- Atlas and axis luxation, 94
- Atony, intestinal, in children, 255
- Auditory canal, foreign bodies in, 297
- Aviation, examinations for, 292

B

- BACTEREMIAS in agonal period, 164
- Bacteriology of chorea, 166
- Balantidium coli, 262
- infection, 165
- Blood, cultivation of meningococcus from, 189
- cultures in pneumonia, 197
- Brain, 17
- and cord, movement of foreign bodies in, 27
- gunshot injuries of, 17
- methods of removing foreign bodies from, 26

- Brain, puncture of, exploratory, 49
- suboccipital, 48
- tumor of, 54
- new principle in treatment of, 55
- Breast, cancer of, 100
- delay in diagnosis of, 101
- operation for, end-results of, 100
- radium in, 105
- recurrence of, after operation, 101
- total excision of pectoral muscles in, 101
- x*-rays in, 102
- surgery of, 17
- Bronchitis in army, 154
- Bronchoscopy, 313
- in cicatricial stricture of esophagus, 320
- in diphtheria, 320
- in diseases, 319
- for foreign bodies, 313

C

- CANCER of breast, 100
- of larynx, 329
- of lip, radium in, 83
- Carbon tetrachloride vapor as a delousing agent, 163
- Cerebral edema, 44
- localization, 56
- Cerebrospinal fever, French methods in treatment of, 187
- serum treatment of, 189
- Cervical lymph nodes, enlargement of, differential diagnosis of, 252
- Chemicals in prophylaxis of pneumonia, 199
- Chemotherapy of experimental pneumococcus infection, 201
- Children, diabetes insipidus in, 251
- diseases of, 245
- effect of war on development of growing, 246
- enuresis in, 251
- epidemic stupor in, 217
- institutional, air space required by, 248
- intestinal atony in, 255
- roentgen examination of chest in, of different ages, 255
- sinus disease in, 305
- standards for growth and nutrition in, 245

Chorea, 166

bacteriology of, 166

Clinic, well babies', 261

Colic, renal, in children, 262

Concussion deafness, 280

Cranioplasty, 37

Cribbing, with dilated stomach and dilated diaphragm, 263

Cultivation of meningococcus from blood, 189

Cysts of hypophysis, 56

D

DEAFNESS, concussion, 280

general, 293

shell shock, 279

Decompression, intracranial trauma and, 42

Dental requirements of recruits, 275

Diabetes insipidus in children, 251

Diphtheria, 306

active immunization of infants against, 167

treatment of carriers, 169

Diphtheroid organisms and Hodgkin's disease, 171

Disease, Hirschsprung's, 262

Hodgkin's, 106

Diseases of children, 245

communicable, in army of United States, 151

infectious, 151

Dislocation, recurrent, of lower jaw, 77

Drainage of cerebral wounds, 26

Dysentery, amebic, 169

oil of chenopodium in treatment of, 169

treatment of, 170

bacillus, vaccination against, 170

E

EAR drums, artificial, 294

protectors, 277

suppurative disease of, 287

Edema, cerebral, 44

Enuresis in children, 251

Epidemic stupor in children, 217

Esophagoscopy, 313

for foreign bodies, 313

Ethylhydrocuprein in acute lobar pneumonia, 201

Eustachian bougies, medicated, 293

Examination of esophagus, 274

fauces, 274

mouth, 274

nose, 274

pharynx, 274

recruits, 272

trachea, 274

Experimental meningococcic meningitis, 188

Exploratory puncture of brain, 49

Eye changes in trench nephritis, 237

F

FACE mask, gauze, protective qualities of, 159

masks, 270

Facial paralysis, 64, 291

Fever, phlebotomous, 194

rat-bite, 219

treatment of, 220

relapsing, endemic in Colorado, 220

scarlet, 220

carriers, 222

etiology of, 220

immune human serum in, 221

trench, 226

association of Rickettsia bodies with, 237

blood transmission experiments in, 230

circulatory disturbances in, 232

clinical history of, 230

diagnosis, differential, 234

etiology of, 229

incubation period, 228

physical examination, 231

prodromata of, 230

rash in, 232

spleen in, 232

symptoms of, 231

virus of, 228

typhoid, 239

Fistula, salivary, 67

Foreign bodies in auditory canal, 297

from brain, methods of removing, 26

movement of, in brain and cord, 27

in nose, 332

Fractures, gunshot, of jaw, 70

G

GAS gangrene and acidemia, 243

Gasserian ganglion, alcoholic injection of, 61

tumors of, 62

Glands, salivary, 67

Goitre, 86

exophthalmic, 86

laryngeal nerve, injury in, 88

Gunshot fractures of jaw, 70

injuries of skull and brain, 17

H

HAY fever, 311

Head, surgery of, 17

Headache, lumbar puncture and, 47

of nasal origin, 301

Health, public, war and, 155

Hearing, tests of, 272

for malingering in, 273

Hearing-test apparatus, new, 276

Hemorrhage from nose, 301

meningeal, in newborn, 50

Hernia of brain, complicating head wounds, 34
Hirschsprung's disease, 262
Hodgkin's disease, 106
 diphtheroid organisms and, 171
 end-results in, 106
Hookworm infection, treatment of, 171
Hydrocephalus, internal, 51
 of poliomyelitis, 213
Hypophysis, cysts of, 56

I

MUNIZATION of infants against diphtheria, 167
Infancy, early, meningitis in, 193
Infant feeding, practical points in, 266
Infants, young, pernicious anemia in, 255
Infection, *balantidium coli*, 165
 hookworm, treatment of, 171
 mouth, 302
 spray, 302
 streptococcus, recent aspects of, 163
 torula, in man, 226
 of upper respiratory tract and acidosis, 161
Infections, respiratory, control of, in military camps, 157
Infectious diseases, 151
Influenza, administrative control of, 179
 epidemic, 172
 treatment of, 178
Influenzal sinus disease, 180
Injuries of malar bone and zygoma, 76
Instruments, new, 298
Intestinal intoxication, 267
Intoxication, intestinal, 267
Intracranial aërocele, 56
 trauma and decompression, 42
 lumbar puncture and, 46

J

J AUNDICE, acute infectious, in United States, 180
 infections, intravenous serotherapy of, 181
Jaw, 70
 ankylosis of, 73
 gunshot fractures of, 70
 lower, recurrent dislocation of, 77
Jaws, tumors of, malignant, surgical treatment of, 81

K

KALA-AZAR in child, 183

L

LARYNGEAL nerve injury in goitre, 88
Laryngectomy, 330
Laryngology, 298
Larynx, cancer of, 329

Larynx, new camp disease of, 327
 projectile in, thyrotomy for, 329
 war surgery of, 328
Leprosy, treatment of, with sodium gynocardate "A," 183
Leptospira icterohemorrhagica, experimental prophylactic inoculation against, 182
 rats and, 180
Leptothrix of Parinaud's conjunctivitis, 195
Lip, cancer of, radium in, 83
Lipovaccines, 156
Localization, cerebral, 56
Lumbar puncture and headache, 47
 and intracranial trauma, 46
Luxation of atlas and axis, 94
 treatment of, 96
Lymph nodes, cervical, enlargement of, differential diagnosis of, 252

M

MALAR bone, injuries of, 76
Masks, 270
Mastitis, bovine, relation of streptococci to, and septic sore-throat, 163
Mastoid operation, radical, 284
Mastoiditis, 282
 acute, as complication of infectious diseases, 162
Measles, 183
 bacteriology of, 183
 German, throat smears in, 183
 possible nature of, 185
 streptococcus and, 184
Meningitis in army, 153
 experimental meningococcic, 188
 mixed infection, 191
 in newborn, 193
 otitic, 288
 tubercular, 288
Meningococci, rapid method for identification of, 191
Meningococcus carriers, 193
 positive intracutaneous reaction in, 190
Military otolaryngology, 269
Milk, 264
 baby that cannot take, 265
 market, 265
 vegetable, 263
 vitamines of, 265
Monilia vaccine in treatment of sprue, 226
Mouth infection, 302
 spray infection, 302
Mumps, 194

N

NECK, 92
 surgery of, 17
 tuberculous glands of, 92
 recurrences in, 92
Nephritis, trench, eye changes in, 237
Neuralgia, trigeminal, 58

- Newborn, meningeal hemorrhage in, 50
 meningitis in, 193
 Nose, foreign body in, 333
 hemorrhage from, 299
 transplants, 298
 Nuzum's antipoliomyelitic serum, 216
 Nystagmus, galvanic tests for, 293
- O**
- Otitic meningitis, 288
 Otolaryngology, military, 269
 Ozena, 299
- P**
- PAPPATACI, 194
 Paralysis, facial, 64, 291
 Pertussis, vaccines in, value of, 196
 Phlebotomous fever, 194
 Pneumococci, partially autolyzed, in pneumonia, 203
 Pneumococcus differentiation, rabbits *versus* white mice in, 198
 infection, experimental, chemotherapy of, 201
 Pneumonia, 197
 acute lobar, 197
 ethylhydrocuprein in, 201
 in army, 153
 blood cultures in, importance of, 197
 influenza, treatment of, by human convalescent serum, 202
 partially autolyzed pneumococci in, 203
 prevention of, 198
 chemicals in, 199
 vaccines in, 199
 Poliomyelitis, 204
 and small laboratory animals, 205
 complement fixation of specific antigen in, 210
 cultivation of virus in, 210
 demonstration of cocci in central nervous system in, 209
 etiology of, 206
 experimental, 204
 physiological stimulation of choroid plexus and, 211
 globoid bodies of, cultivation of, 207
 human, observations with material from domestic animals associated with cases of, 205
 hydrocephalus of, 213
 passage of neutralizing substance from blood into cerebrospinal fluid in actively immunized monkeys in, 212
 pathology of, 212
 serum, Nuzum's, 216
 Rosenow's, in treatment of, 215
 spinal fluid in, 214
 streptococcus and, 208
 pleomorphic, agglutination of, in, 209
 virus of, carriage of, and subsequent infection, 205
 Poliomyelitis, virus of, survival of, in brain of rabbit, 210
 Protective therapy for varicella, 240
 Protectors, ear, 278
 Pyloric spasm, 258
 stenosis, congenital, 258
- R**
- Radium in cancer of lip, 83
 in superior maxilla tumor, 78
 Rat-bite fever, 219
 Rats and leptospira icterohemorrhagica, 180
 Recruits, dental requirements of, 275
 examination of, 272
 Relapsing fever endemic in Colorado, 220
 Renal colic in children, 262
 Resection of auriculotemporal nerve, 68
 Retropharyngeal abscess, 83
 Rhinology, 269, 298
 Roentgen examination of chest in children of different ages, 255
 Rosenow's serum in treatment of poliomyelitis, 215
- S**
- SALIVARY fistula, 67
 glands, 67
 Scalp wounds, 19
 Scarlet fever, 220
 in army, 154
 carriers, 222
 etiology of, 220
 immune human serum in, 221
 Septum, deflected, 301
 submucous resection of, 301
 Serotherapy, intravenous, of infectious jaundice, 181
 Serum, antimeningococcic, potency of, 186
 antipneumococcus, in lobar pneumonia, 203
 potency of, 203
 antipoliomyelitic, Nuzum's, 216
 Rosenow's, value of, 215
 human convalescent, in treatment of influenza pneumonia, 202
 immune, human, in scarlet fever, 221
 Rosenow's, in treatment of poliomyelitis, 215
 therapeutic value of, 215
 therapy of trichinosis, 239
 treatment of cerebrospinal fever, 189
 Shell shock deafness, 279
 Shin-bone fever, 232
 Sinus disease, 305
 in children, 307
 influenzal, 180
 thrombosis, 289
 superior longitudinal, wounds of, 27
 Skull, gunshot injuries of, 17
 Smallpox, 222
 at Eagle Pass, 222
 vaccination against, intradermal, 223

- Smallpox, vaccine of, pure, cultivated *in vivo*, 224
- Sodium gynocardate "A," in leprosy, 183
- Sore-throat, septic, relation of streptococci to bovine mastitis and, 163
- Spasm, pyloric, 258
- Spinal fluid in poliomyelitis, 214
- Sporotrichosis following a mouse bite, 225
- Sprue, monilia vaccine in treatment of, 226
- Standards for growth and nutrition in children, 245
- Status lymphaticus, 261
- Stenosis, pyloric, congenital, 258
- Strain, voice, 326
- Streptococci, relation of, to bovine mastitis and septic sore-throat, 163
- Streptococcus infection, recent aspects of, 163
- Stupor, epidemic, in children, 217
- Suboccipital puncture, 48
- Suppurative disease of ear, 287
- Surgery of head, neck and breast, 17
- T**
- Tests for malingering in hearing, 273
galvanic, for nystagmus, 293
of hearing, 272
- Thrombosis, sinus, 289
medicinal treatment of, 290
surgical treatment of, 289
- Thyroid tumor of tongue, aberrant, 91
- Tongue, aberrant thyroid tumor of, 91
- Tonsils, 321
infection from, incompletely removed, 323
- Torticollis, 97
etiology of, 97
secondary skeletal alterations in, 98
treatment of, 99
- Torula infection in man, 226
- Transplants, nose, 298
- Trench fever, 226
association of Rickettsia bodies with, 237
blood transmission experiments in, 230
circulatory disturbances in, 232
clinical history of, 230
diagnosis of, differential, 234
etiology of, 229
incubation period, 228
physical examination in, 231
prodromata of, 230
rash in, 232
spleen in, 232
symptoms of, 231
virus of, 228
nephritis, eye changes in, 237
- Trichinosis, 238
serum therapy of, 239
- Trichloroacetic acid in Vincent's angina, 243
- Trigeminal neuralgia, 58
- Tubercular meningitis, 288
- Tuberculosis of larynx, 331
- Tumor of brain, 54
of Gasserian ganglion, 62
of jaws, malignant, surgical treatment of, 81
of superior maxilla, radium in, 78
- Typhoid fever, 239
in army, 154
atropine test in diagnosis of, 239
in a company of immunized soldiers, 239
- V**
- VACCINATION against dysentery bacillus, 170
against smallpox, intradermal, 223
- Vaccine, monilia, in treatment of sprue, 226
- Vaccines in pertussis, value of, 196
in prophylaxis of pneumonia, 199
sensitized, in prophylaxis and treatment of infections, 161
- Varicella, protective therapy for, 240
- Vegetable milk, 263
- Vertigo, 292
- Vincent's angina, 325
in an unusual form, 241
- Voice strain, 326
- W**
- WAR and public health, 155
- Well babies' clinic, 261
- Wounds, cerebral, drainage of, 26
gunshot, of head, acute pulmonary edema in, 28
complications of, 28, 33
involving fracture of skull but no penetration of dura, 32
mortality in, 32
remote results of, 28
with scalp wounds, 33
- of scalp, 19
- of superior longitudinal sinus, 27
- X**
- X-RAYS in cervical adenitis, 93
- Z**
- ZYGOMA, injuries of, 76

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